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NATIONAL DAM SAFETY PROGRAM. RAVINE LAKE DAM (NJ 00362), RARITA--ETC(U)
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LEVEL II

RARITAN RIVER BASIN
NORTH BRANCH RARITAN RIVER
SOMERSET COUNTY
NEW JERSEY

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RAVINE LAKE DAM
NJ 00362

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

May, 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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17. DISTRIBUTION STATEMENT

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Spillways
Structural Analysis
Visual Inspection
Ravine Lake Dam, N.J.
National Dam Inspection Act Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and prelim[illegible]y structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE – 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

15 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Ravine Lake Dam in Somerset County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Ravine Lake Dam, a high hazard potential structure, is judged to be in good overall condition. However, the spillway is considered seriously inadequate since 11 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, nonemergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during

periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be made to assess the hazard represented by the nearby seismically active fault. If a significant hazard is determined, then a seismic analysis should be performed, along with the seepage and stability analyses that are normally recommended for high hazard dams.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Drain and repair the manhole for the emergency valve controls. Clean out the drains of the manhole.

(2) At the same time, check the condition of the emergency gate valve and determine why the valve is so difficult to operate. Make any necessary repairs.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Replace the granite slab manhole cover for the emergency valve controls with a cover that can be opened by one man.

(2) Repair leaks in the dam and seepage in the right abutment. Replace loose mortar.

(3) Regularly operate the emergency control valve to check its performance and to flush out any sediments in the intake area.

(4) Initiate a program of annual inspections, inspections after overtopping events and recording of all maintenance work.

(5) Install survey markers on the top of the dam to monitor any future deflections of the dam.

NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congresswoman Millicent Fenwick of the Fifth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
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Trenton, NJ 08625

RAVINE LAKE DAM (NJ00362)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 4 and 21 December 1978 by Jenny-Leedshill Engineers under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspèction Act, Public Law 92-367.

Ravine Lake Dam, a high hazard potential structure, is judged to be in good overall condition. However, the spillway is considered seriously inadequate since 11 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be made to assess the hazard represented by the nearby seismically active fault. If a significant hazard is determined, then a seismic analysis should be performed, along with the seepage and stability analyses that are normally recommended for high hazard dams.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Drain and repair the manhole for the emergency valve controls. Clean out the drains of the manhole.

(2) At the same time, check the condition of the emergency gate valve and determine why the valve is so difficult to operate. Make any necessary repairs.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Replace the granite slab manhole cover for the emergency valve controls with a cover that can be opened by one man.

(2) Repair leaks in the dam and seepage in the right abutment. Replace loose mortar.

(3) Regularly operate the emergency control valve to check its performance and to flush out any sediments in the intake area.

(4) Initiate a program of annual inspections, inspections after overtopping events and recording of all maintenance work.

(5) Install survey markers on the top of the dam to monitor any future deflections of the dam.

APPROVED: James G. Ton
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 11 May 1979

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT. CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA. PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

11 APR 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Ravine Lake Dam (Federal I.D. No. 00362), a high hazard potential structure, has recently been inspected. The dam is owned by the Ravine Association and is located on the North Branch of the Raritan River near Peapack, Somerset County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate since approximately 11 percent of the Probable Maximum Flood would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. Develop and initiate a detailed emergency operation plan and downstream warning system. Also, around-the-clock surveillance should be provided during periods of unusually heavy precipitation.

NAPEN-D
Honorable Brendan T. Byrne

A final report on this Phase I Inspection with a detailed analysis of the situation, will be forwarded to you within two months.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Cy Furn:
Dirk C. Hofman, Actg. Deputy Director
Division of Water Resources
N.J. Dept of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
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P.O. Box CN029
Trenton, NJ 08625

UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Ravine Lake

b. ID NO.: NJ00362

d. HEIGHT: 35 Feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 500 ac. ft.

f. TYPE: Gravity Section Rock Masonry

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 11 Apr 79

l. URGENCY CATEGORY: UNSAFE, Non-Emergency

m. EMERGENCY ACTIONS TAKEN:
Gov. notified of this condition by District Engineer's letter of 11 Apr 79.

n. REMEDIAL ACTIONS TAKEN:
N.J.D.E.P. will notify dam's owner upon receipt of our letter.

o. REMARKS: Final report, to be issued within six weeks, will have WHITE cover.

c. LOCATION <u>State</u>: New Jersey <u>County</u>: Somerset

<u>River or Stream</u>: North Branch Raritan River

<u>Nearest D/D City or Town</u>: Far Hills

g. OWNER: Ravine Association

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT
Preliminary report calculations indicate 11% of PMF would overtop the dam.

j. DESCRIPTION OF DANGER INVOLVED:
Overtopping and failure of the dam significantly increases hazard potential to loss of life and property downstream of dam.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of date of District Engineer letter the owner do the following:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measur required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusually heavy precipitation.

for A. J. Braun 7/20/79
W. H. ZINK, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Ravine Lake, Fed. I.D. No. NJ 00362
State Located:	New Jersey
County Located:	Somerset
Stream:	North Branch Raritan River
Dates of Inspection:	December 4 and 21, 1978

Brief Assessment of General Condition of Dam

Structurally, the dam appears to be in good overall condition.

The spillway of the dam is seriously inadequate and can pass only about 10 percent of the Probable Maximum Flood. The dam has been overtopped several times and on at least one of these occasions an unknown amount of material was eroded from the left abutment.

The stone masonry shows little indication of deterioration, although some of the mortar joints are in need of repair. No cracks or other signs of distress were observed. There is a small amount of leakage at several locations on the face of the dam, and there is seepage through the right abutment, none of which is considered to imperil the immediate safety of the dam at the present rate of flow.

It is recommended that the manhole housing the emergency outlet be dewatered and the drains repaired soon, along with any repairs of the gate valve that may be necessary. Other recommendations are of a less urgent nature and should be implemented in the near future. These include modification of the valve manhole cover

for 1-man operation, repair of leakage in the dam and right abutment, replacement of loose mortar in joints, regular operation of the emergency outlet valve, annual inspection of the dam, keeping records of maintenance work, implementation of a warning system, and installation of survey markers on the top of the dam. It is also recommended that an assessment be made in the near future of the seismic hazard and that, if such hazard is found to exist, a seismic analysis along with seepage and stability analyses be made.

More detailed and sophisticated hydraulic and hydrologic studies to more accurately determine the spillway capacity should be undertaken by the owner within 6 months. Remedial action, as a result of these studies, should be initiated within one year. In the interim a warning and evacuation plan should be implemented to provide adequate warning to downstream residents. Also, surveillance of the dam should be provided during periods of heavy precipitation.

Frank L. Panuzio

Frank L. Panuzio, P.E.
Project Manager

R J Jenny

Robert J. Jenny, P.E.
Project Director
New Jersey License No. 9878

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PLATES

APPENDICES

TABLE OF CONTENTS
(Continued)

RAVINE LAKE DAM
Downstream face of dam.
(December 4, 1978)

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

RAVINE LAKE DAM
Federal I.D. No. NJ 00362
New Jersey I.D. No. 25-54

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act, Public Law 92-367, 1972, provides for the National Inventory and Inspection Program by the U. S. Army Corps of Engineers. This report has been prepared in accordance with this authority, through contract between the State of New Jersey and Jenny-Leedshill Engineers. The State of New Jersey has also entered into an agreement with the U. S. Army Engineer District, Philadelphia, to have this work performed.

b. Purpose of Inspection

The purpose of this inspection was to evaluate the general structural integrity and hydraulic adequacy of the dam, and to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Description of Dam and Appurtenances

Ravine Lake Dam is a gravity section rock masonry structure which impounds a 500 acre-feet reservoir on the North Branch Raritan River. The dam is 45 feet high, 276 feet long and is arched in plan on a radius of 500 feet. The upstream face is nearly vertical with only a slight batter, while the downstream face is cut

stone built in steps varying from 24 inches in height at the toe to 17 inches near the crest.

The spillway is in the center of the dam and consists of a 160-foot long overflow section with a 25-foot long, 6-inch deep depressed center section. The width of the crest is 6.25 feet. Wing walls rise 3.5 feet above both sides of the spillway.

On the left side of the dam is a 6-inch diameter outlet pipe and gate valve which control flow to a downstream pump station. Near the base of the right side of the dam is a 48-inch diameter emergency outlet which is controlled by a gate valve operated by an extension stem in a manhole at the top of the dam.

b. Location

The dam is located in Somerset County in north-central New Jersey near Peapack, about 25 miles west of Newark. It is accessible via local roads off U.S. Highway 206. The location of the dam is shown on Plate 1.

c. Size Classification

The size classification of the dam is intermediate, based on its structural height of 45.4 feet and its 500 acre feet maximum reservoir storage capacity. An intermediate size dam is defined in the Corps' Guidelines as one in which the height of the dam is equal to or greater than 40 feet and less than 100 feet, and/or the reservoir capacity is equal to or greater than 1,000 acre feet and less than 50,000 acre feet.

d. Hazard Classification

The dam is considered to be a high hazard dam, since, if the dam should fail for any reason during

non-flood season, the large volume of water released could result in extensive property damage and possible loss of more than a few lives in the area immediately downstream and in the Borough of Far Hills, (population 800) 2-1/2 miles downstream, and in Bedminster Township (population 2,600) further downstream. There are 6 houses within the flood plain immediately downstream, and maps indicate that perhaps a dozen houses are endangered in the downstream communities.

e. Ownership

The dam is owned and maintained by the Ravine Association, P.O. Box 351, Far Hills, New Jersey, 07931.

f. Purpose of Dam

The dam impounds a reservoir which is used for scenic and recreational purposes. In the summer a small amount of water is also pumped to the Blairsden estate to supply ponds and fountains.

g. Design and Construction History

The dam was constructed in 1898-1899 by the Ravine Association. A bronze plaque on the dam identifies it as North Branch Dam. George W. Howell of Morristown, New Jersey was the engineer and F.S. Tainter was the contracting engineer. The reservoir has been drawn down several times for inspection, for pointing of mortar joints and dredging of the lake. State records indicate that the dam and reservoir at one time furnished a private power supply, but this cannot be confirmed.

h. Normal Operational Procedures

The reservoir level is essentially uncontrolled. Small releases are made in the summer to a down-

stream pump station. The emergency outlet is only occasionally operated to make repairs or inspections of the dam. There are no monitoring devices on the dam.

1.3 Pertinent Data

a. Drainage Area - 26.2 square miles

b. Discharge at Damsite

- Maximum known flood at damsite - Not known. (Newspaper account indicates dam was overtopped by 7.2 feet on August 28, 1971 by Hurricane Doria flood.)
- Ungated spillway capacity at maximum pool elevation - 3140 cfs.
- Total spillway capacity at maximum pool elevation - 3140 cfs.

c. Elevation (ft. above MSL)

· Top Dam	230.2
· Spillway crest	
- Main section	226.69
- Depressed section	226.17
· Streambed at centerline of dam	195 (Approx.)

d. Reservoir

· Length of maximum pool	4900 ft.
· Length of recreation pool (spillway crest)	4400 ft.

e. Storage (acre-feet)

· Recreation pool (spillway crest)	320
· Top of dam	500

f. Reservoir Surface (acres)

· Top dam	54
· Spillway crest	38

g. Dam

. Type	Rock masonry gravity, arched to 500 ft. radius
. Length	
- Including Footings	315 ft.
- Exposed Crest	276 ft.
. Height	45.4 ft. (structural height)
. Top Width	5.6 ft.
. Side Slopes	
- Upstream	Slight batter
- Downstream	Stepped, 1H:1.2V
. Core	Rubble concrete
. Cutoff	2.5 ft. wide by 2.5 ft. deep, at upstream toe

h. Spillway

. Type	Broad creasted weir, 6.25 ft. wide
. Length of weir	
- Total	160 ft.
- Depressed section	25.5 ft.
. Crest elevation	
- Main section	226.69 ft.
- Depressed section	226.17 ft.
. U/S Channel	Reservoir
. D/S Channel	Stepped downstream face of dam and natural channel of river

i. Regulating Outlets

. 1-6 in. diameter pipe for water supply

. 1-48 in. diameter emergency outlet

SECTION 2: ENGINEERING DATA

2.1 Design

a. Geological Conditions

Ravine Lake Dam is near the eastern border of the New Jersey Highlands physiographic province. The regional geology of this province is discussed in detail in Appendix C to this report.

Ravine Lake is well named, being situated within a deep, steep walled, narrow ravine with shallow bedrock. The ground rises abruptly for more than 300 feet on both abutments. Bedrock is exposed on the right abutment almost continuously up from the toe of the dam, and on the left abutment for some distance up from the toe. There is little doubt that the dam abutments are constructed on rock, and the narrow valley configuration tends to confirm drawings indicating that the entire dam is built on bedrock. Bedrock in the area is a pink granite which is very competent, although jointed. Weathered surface rock is typically less than one foot thick.

The dam site is well south of the Wisconsin glacial period terminal moraine. Therefore, the thin overburden observed on the valley walls is composed primarily of old, weathered glacial tills which were deposited by earlier continental glaciers. In the valley bottom, recent alluvium, composed primarily of sands, gravels and cobbles, were seen in the stream bottom. It would appear that finer grained materials could be reasonable expected in the narrow flood plain adjacent to the active stream bed.

The dam is situated in a Seismic Zone 1 indicating only minor potential damage from distant earthquakes.

However, because of its position less than 5 miles from a major mapped fault zone which is theorized to be a continuation of the seismically active Ramapo Fault, consideration should be given to an investigation of the seismic stability of the dam.

b. Design Data

The dam is shown in plan and elevation on Plates 2 and D-1 (Appendix D), and in section on Plates 3 and D-2. Plates 2 and 3 are believed to be as-built drawings, while Plates D-1 and D-2 were drawn from measurements made in 1915. Specifications were obtained from the owner but they differ from the as-built construction in certain respects. No design calculations or reports are available.

The specifications called for buttresses at each end of the spillway and earthfill embankments extending from the buttresses to the abutments. The dam was not constructed in this manner, but in other respects the specifications are believed to describe design features. The dam was designed with a core of rubble concrete, an upstream wall of uncoursed rubble laid in mortar, and a downstream wall of ashlar masonry (cut stone) laid in steps with mortared joints. Steps on the downstream wall were to decrease in vertical dimension from 24 inches at the toe to 18 inches near the crest. Specifications called for mortar for pointing to be 1 part cement to 1 part sand, and all other mortar to be 1 part cement to 3 parts sand. The concrete matrix was specified as 1 part cement, 3 parts sand and 4.5 parts gravel.

2.2 Construction

The construction of the dam is believed to have been along the lines as represented on Plates 2 and 3 and as

described in pertinent parts of the specifications. It was specified that the foundation area be stripped to sound bedrock and all cracks and crevaces filled with a thin grout broomed over the rock. As indicated on Plate 2, a shallow cutoff wall was installed at the upstream toe, and the core and downstream toe were keyed into the foundation rock. Footings were apparently carried well into the abutments, beyond the wing walls (Plate 2).

It was specified that the concrete in the core be placed in 6-inch layers and that the upstream and downstream faces be carried up along with the core, keeping about 3 feet higher than the core. The core wall was to be constructed without continuous horizontal or vertical joints, and the stones were to be placed 6 inches apart. The coping stones on the spillway were to be anchored to the dam with iron bolts and tied to each other with clamps.

2.3 Operation

There is a staff gage at the dam but records of reservoir levels are not kept by the owner. A U. S. Geological Survey gaging station is maintained just upstream of the dam.

Some records of maintenance work and inspections are available as described in Section 4.2. There are no monitoring devices on the dam.

2.4 Evaluation

a. Availability

Data on design and construction are limited to specifications and as-built drawings. Some data are available on maintenance and repair work. All available data are listed in Appendix A.

b. Adequacy

Available data are insufficient to adequately evaluate the design. Calculations relating to the structural design of the dam or the stability of the as-built structure are not available. Knowledge of construction methods is limited, and nothing is known of as-built material properties. Foundation conditions are not well known.

c. Validity

Specifications differ in certain respects from the manner in which the dam was actually constructed, but with respect to the foundation treatment and masonry construction, the specifications are believed to approximate the construction practices that were actually followed. The as-built drawings, although old, appear to reflect the present configuration of the dam.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The visual inspections of Ravine Lake Dam were made on December 4 and 21, 1978. The water surface elevation at the time of the first inspection was 226.75 feet, or just above the crest of the main spillway section. No releases were being made through the outlets at the time.

The visual inspection did not reveal any critical signs of distress in the dam. Seepage was observed at several locations on the dam but none appeared to be of a critical nature. The emergency outlet is not operated on a regular basis and the manhole housing this valve was filled with water.

Detailed inspection was made of the dam, appurtenant structures, reservoir area, and the downstream channel. Descriptions of the findings of these inspections are summarized in the paragraphs which follow. The checklist of visual inspection items is included in Appendix A. Geologic and foundation conditions observed at the time of inspection are noted in greater detail in Section 2.1-a.

b. Dam

The dam was inspected for signs of settlement, seepage, spalling, cracking and any other evidence of undesirable behavior which might affect the stability of the structure. Because water was flowing over the entire length of spillway, much of the downstream face of the dam was not accessible for inspection (Photo 1).

Several areas of leakage were observed on the downstream face of the dam. Three small leaks were observed

on the left (east) side of the dam near the 6-inch valve chamber. The seepage is through the mortar joints, and the adjacent rock masonry is commonly iron-stained. On the right (west) side of the dam several leaks, totaling about 0.5 gpm, were noted about 10 feet below the crest of the dam (Photo 2).

At the junction of the dam and the right abutment there was seepage of about 3 gpm at a point 11 feet below the dam crest (Photo 3). The seepage appears to be originating in the abutment and probably represents flow through joints or fractures in the bedrock.

Little of the upstream face of the dam was visible. The mortar on the uncoursed rubble wall appeared to be sound, insofar as could be observed (Photo 4).

c. Appurtenant Structures

Spillway

At the time of inspection the major flow of water was through the depressed central section of the spillway, with lesser flow over the storm overflow sections on either side. Although it was not possible to closely inspect the spillway, the uniform flow of water indicated that there were no major discontinuities or failures of the sill (Photo 5).

Outlets

The manhole housing the 6-inch outlet valve on the left side of the dam was dry and appeared to be in satisfactory condition (Photo 6). A log boom is installed over the inlet in the reservoir (Photo 4).

The 48-inch emergency outlet on the right side of the dam showed no indication of leakage (Photo 7). An 8-inch thick granite slab with a 4-inch diameter hole in

it covers the manhole housing the emergency outlet valve (Photo 8). In event of an emergency this slab would be difficult to move. The manhole was filled with water to the level of the reservoir, a condition noted in previous inspections (Appendix D).

d. Reservoir Area

Water in the reservoir appeared to be clean and without odor. Only a minor amount of debris was noted, but the steep wooded slopes do afford debris potential (Photo 9). The slopes appear to be stable and there is no indication of previous slides. Some sedimentation was noted at the abutments. Previous reports indicate a siltation problem.

On the foundation of the gaging station on the left bank, the high water mark of the 1971 Hurricane Doria flood is noted (Photo 10). This and other floods overtopped the dam.

e. Downstream Channel

A stilling pool extends about 200 feet downstream of the dam. The river below the pool is slightly meandering and has a steep gradient (Photo 11). Slopes on the right bank are steep and wooded and those on the left bank are moderately steep. A bridge about ¼ mile downstream has partially failed and 2 of the arched openings have been filled with gravel (Photo 12). Several houses are located on the left bank near this bridge.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The reservoir is operated primarily for its scenic and recreational value and only secondarily as a source of water that is pumped to a nearby estate during summer months. There is no regulation of reservoir levels other than for occasional inspections and maintenance work.

Siltation has been a problem and as early as 1915 there was an accumulation of 12 feet of sediments behind the dam (see Appendix D, de B. Parsons report). The upper end of the lake was apparently dredged in about 1949 (Plate 4). The present depth of sediments behind the dam is not known.

4.2 Maintenance of Dam

Reports were obtained on 5 previous dam inspections dating from 1915 to 1973. These reports are included herein as Appendix D. The leakages through the dam at the right abutment which were noted in the present inspection are apparently the same as those reported in previous inspections. The report by Agpar Associates in 1973 noted a sewage odor from seepage at the right abutment. This odor was not detected during the present inspection and it is suggested that the odor may have resulted from seepage of stagnant reservoir water under conditions of thermal stratification that could have prevailed at the time of the former inspection.

No records of maintenance work were available and it is not known whether the recommendations of previous inspection reports were implemented.

Other than the staff gage, there are no instrumentation or monitoring systems on the dam or reservoir.

4.3 Maintenance of Operating Facilities

The emergency outlet is apparently operated only occasionally. The manhole housing the valve controls is flooded and has been for some time. The valve is reported to be difficult to operate. It is not known what maintenance work has been done.

4.4 Description of Warning Systems

There is apparently no warning system or emergency contingency plan in event of possible failure of the dam.

4.5 Evaluation of Operational Adequacy

Records indicate that there have been some infrequent inspections of the dam, including some inspections made when the reservoir has been drawn down. No records are available on what maintenance work was done as a result of these inspections.

Access to the emergency outlet controls is difficult, since the controls are remote from the highway. The granite slab covering the control manhole is very heavy and would be difficult to remove. It is not known whether the controls can be operated when the manhole is flooded, as it now is. If not, the necessity of pumping out this water before operating the valve would impose a serious operational shortcoming.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The capacity of Ravine Lake is estimated to be 320 acre-feet at the spillway crest and 500 acre-feet at the top of dam. The structural height is 45.4 feet. In accordance with Corps' guidelines, the dam is classified as intermediate size. There are several dwellings near the river banks downstream of the dam and, therefore, failure or misoperation of the dam would result in an excessive downstream hazard and loss of lives and property damage. In accordance with the Corps' Guidelines, the dam is classified as high hazard and the Spillway Design Flood (SDF) is the Probable Maximum Flood (PMF).

Data obtained from State files indicated the drainage basin area of the dam is 26.2 square miles. Elevations range from a maximum of about 1100 feet mean sea level along the northern perimeter of the drainage basin to about 240 feet mean sea level in the valley floor. Only a small portion of the land within the watershed is occupied by commercial, industrial or residential development. About 0.2 percent of the watershed area is the reservoir of the dam. The drainage basin is delineated on a U.S.G.S. topographic map and is presented on Plate E-1, Appendix E.

The hydraulic and hydrologic features of the dam were evaluated using criteria set forth in the Corps of Engineers, "Recommended Guidelines for Safety Inspection of Dams," and additional guidance and criteria provided by the Philadelphia District, Corps of Engineers.

The analysis was conducted using the Corps' computer program HEC-1, Dam Break Version, (HEC-1, DB).

The Philadelphia District of the Corps of Engineers supplied the PMF inflow hydrograph to be used in the analysis of Ravine Lake Dam. Using this inflow hydrograph, the HEC-1, DB program computed the peak inflows of the 5 percent, 25 percent, 50 percent and 100 percent PMF. These discharges are 1700 cfs, 8500 cfs, 17000 cfs, and 34000 cfs, respectively.

The various percentages of the PMF inflow hydrograph were routed through the reservoir using the Modified Puls Method by the HEC-1, DB program. The peak outflow discharges of the 5 percent, 25 percent, 50 percent and 100 percent PMF were calculated to be approximately 1630 cfs, 8270 cfs, 16530 cfs and 31600 cfs, respectively. The flood routings indicate that all floods greater than about 10 percent of the PMF will overtop the dam. A plot of percent PMF versus peak outflow discharge is presented as Plate E-2 in Appendix E.

The spillway and overtop stage-discharge rating curve used in the flood routings was calculated using the weir equation and assuming free overflow across the entire length of the dam and spillway. The spillway is a 6.3-feet wide broad crested weir with a reported discharge coefficient of 2.9. The reservoir stage-storage curve was determined from U.S.G.S. 7.5-minute topographic maps and data obtained from State files. This stage-storage curve was extended above the dam crest to include surcharge storage during peak flood discharges. In the reservoir routing computations possible discharges through the outlet works were excluded because their capacity is small compared to the PMF and because of the possibility that the outlet valves may be closed.

The stage-storage and the spillway and overtop stage-discharge curves are presented in Appendix E as Plates E-3 and E-4, respectively.

The various percentages of the PMF were routed 2.7 miles downstream through three successive reaches to the communities of Bedminster and Far Hills. These routings were made to determine downstream flooding characteristics without dam failure. These flooding characteristics were compared to those that would result assuming the dam fails because of the inadequate capacity of its spillway. From this comparison the seriousness of the spillway's inadequacy was assessed.

The hydraulic parameters used in the HEC-1DB program for the downstream routing calculations were estimated based on observations made in the field and information obtained from U.S.G.S. topographic maps. The locations of the channel cross-sections used in these routings are shown on page E-4, Appendix E.

The HEC-1DB computer program was not used as a model for the failure of Ravine Lake Dam because if the dam were to fail it would fail rapidly and completely and at a time when it is being overtopped a significant amount. Under these failure conditions the HEC-1DB program gives erroneous answers for the reason discussed in the following paragraph.

From discussions with Mr. Paul Ely of the Corps' HEC center in Davis, California, it was learned that in the dam break flood routing calculations the HEC-1DB program does not subtract from the total spillway, dam crest and breach outflow discharges the discharge over the dam crest that occurs in the breached section of the dam. This "double counting" of flows results in a large overestimate of the peak outflow discharge whenever

flow over the top of dam represents a significant portion of the calculated peak outflow discharge and when the breach width is a significant portion of the dam crest length.

In order to assess the increase in downstream flood hazard resulting from dam failure the peak dam break discharge was calculated manually. In these calculations it was assumed the dam would fail completely and instantaneously and at the time of maximum overtopping. The peak outflow discharges at the damsite were calculated using dam-break flow velocities and depths presented in text books on open channel hydraulics[1]. Peak discharges at downstream locations were estimated using attentuation factors, i.e., the ratios of downstream discharge to damsite discharge, that were calculated by HEC-1DB program for the non-breach analysis.

In this manner, the flooding characteristics at the communities of Bedminster and Far Hills were estimated assuming dam failure. The following tabulation compares these characteristics with the flooding characteristics assuming no failure of the dam and indicates that those structures described in Section 1.2d would probably be inundated.

	25% PMF	50% PMF	100% PMF
No Breaching			
Peak Discharge, cfs	7970	15990	31260
Peak Flow Depth, ft	9.4	12.8	17.1
Peak Flow Width, ft	350	490	660
Peak Flow Velocity, fps	5.0	5.3	5.7
Breaching			
Peak Discharge, cfs	49890	58500	73280
Peak Flow Depth, ft	20.7	22.0	24.0
Peak Flow Width, ft	755	780	820
Peak Flow Velocity, fps	6.2	6.5	6.9

[1]See Henderson, "Open Channel Hydraulics," Macmillan Series in Civil Engineering, 1966, p. 304.

As shown in the above tabulation, there is a significant increase in the downstream flood depth and, therefor, a significant increase in the hazard to loss of life and property damage should the dam fail.

It is reported that the only emergency drain for the reservoir is a 48-inch diameter pipe through the dam. No detailed information on this drain is available. Using the orifice flow equation, the time required to drain the reservoir from a spillway full condition was calculated to be about 19 hours. This estimate assumes no tailwater and no inflows into the reservoir.

b. Experience Data

Records of lake levels are not maintained for this site, although there is a gaging station at the damsite. The reservoir is unregulated, used for recreation and therefore is generally at or near its spillway level. It is known that the dam has been overtopped several times but the damages resulting from these floods is not known.

c. Visual Observations

There is a well-defined channel downstream of the embankment. Dwellings were observed on the left bank of the immediate downstream channel. The flood plain below the dam contains a fairly dense stand of medium and small trees with some undergrowth (Photos 11 and 12).

d. Overtopping Potential

As indicated in Section 5.1-a, the Ravine Lake Dam spillway can pass only 10 percent of the PMF. Downstream flooding hazards that would result should the dam fail are significantly higher than those that would exist without failure or just prior to failure. In accordance with the Corps' guidelines, the existing spillway for Ravine Lake Dam is classified as Seriously Inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no visible indications of any major distress in the dam. The stone masonry shows no signs of deterioration but the mortar between the stones requires some maintenance. The spillway crest could not be closely inspected, but the flow of water over the crest is uniform.

There are a number of small leaks eminating from the mortar joints on the face of the dam. Most or all of these leaks have been noted in previous inspections. In an inspection made in 1973, when the reservoir had been lowered below the spillway level, the total leakage through, around and under the dam was estimated to be about 35 gpm (Appendix D, Apgar Associates). The same inspectors estimated an additional flow of 15 gpm from the seep in the right abutment. The rate of seepage from this same location was estimated to be about 3 gpm at the time of the present inspection. It is believed that the leakage through the dam and the seepage from the right abutment do not impair the structural stability of the dam. Any future increase in the rate of seepage or leakage would, of course, be cause for concern.

b. Design and Construction Data

No design drawings or calculations are available. The drawings that are available are believed to represent the as-built configuration of the dam (Plates 2 and 3). The drawings show little detail and there is no information on the 2 outlets or certain details such

as the retaining walls on the left abutment. Of significance, though, are details shown of the foundation, which is indicated to extend into bedrock and well into both abutments on either side of the dam. Since the dam has been overtopped several times, the extension of the foundation into the abutments contributes to the stability to this part of the structure. The arched shape of the dam undoubtedly contributes to the stability also.

c. Operating Records

There are no operating records of the reservoir, since it is not regulated. There are records of inspections of the dam but no records of repairs or implementation of recommendations as set forth in the inspection reports.

d. Post-Construction Changes

No major post-construction changes to the dam are known to have been made. Compacted fill was apparently placed on the left abutment to replace soil washed out by the 1971 storm (Appendix D, Apgar Associates).

e. Seismic Stability

The dam is located in Seismic Zone 1, in which it may generally be assumed that there is no hazard from earthquake, provided static stability conditions are satisfactory and conventional safety margins exist. However, as pointed out in Section 2.1-a, the dam is less than 5 miles from a possible continuation of the seismically active Ramapo fault. Data are insufficient at this time to assess seismic stability, should a significant earthquake occur along this fault in the vicinity of the dam.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The spillway of the dam is seriously inadequate and can pass only about 10 percent of the Probable Maximum Flood. The dam is known to have been overtopped as early as 1901 and as recently as 1971. Considering the 80-year history of the dam, it has performed remarkably well.

The left abutment is of concern in the event of severe overtopping. Depth of bedrock in this area is not known. The foundation is indicated in plans to extend into rock for some distance beyond the crest of the left side of the dam, a factor which contributes some safety. However, the abutment did suffer some erosion damage in the 1971 flood and was apparently repaired by placing compacted fill in this area.

Leakage through the dam does not appear to be excessive, and the rate of flow is about the same as was reported in several previous inspections. Seepage through the right abutment has occurred for many years but as long as the rate of flow does not increase, this seepage is not considered to be a serious threat to the immediate safety of the dam.

The dam is within 5 miles of what is believed to be an extension of a seismically active fault. The hazard that this condition represents cannot be assessed at this time.

The emergency outlet is capable of draining the reservoir in only 19 hours. However, access to the outlet is difficult, the manhole cover to the controls

is heavy and hard to move, the manhole is flooded, and the gate valve is reportedly difficult to operate. These conditions would make emergency operation of the outlet inordinately slow.

b. Adequacy of Information

Data are insufficient to evaluate the stability of the dam, since no information is available on the physical properties of the dam and foundation. Information is also needed on the nature and operation of the outlet valves.

c. Urgency

The manhole to the emergency outlet valve should be dewatered and repaired soon. Other recommendations are of a less urgent nature and should be implemented in the near future.

d. Necessity of Additional Data/Evaluation

An evaluation is needed of the hazard represented by the proximity of the dam to a fault which is believed to be seismically active.

Corps of Engineers Guidelines require that, in general, seepage and stability analyses should be on record for all dams in the high hazard category. Although the structural stability and seepage characteristics of the dam appear satisfactory, based on the visual inspection and the long history of satisfactory performance of the dam, such analyses should be made along with a seismic analysis, if the aforementioned evaluation of seismic hazard indicates that high ground accelerations could be expected at the dam. The borings and laboratory tests required for such analyses would also furnish needed information on foundation conditions in the left abutment.

Drawings and other information are needed on the details of the outlets.

More detailed and sophisticated hydraulic and hydrologic studies to more accurately determine the spillway capacity should be undertaken by the owner within 6 months. Remedial action, as a result of these studies, should be initiated within one year.

7.2 Remedial Measures

a. Remedial Work

It is recommended that the owner perform the following remedial measures:

1. Drain and repair the manhole for the emergency valve controls. Clean out the drains of the manhole.

2. At the same time, check the condition of the emergency gate valve and determine why the valve is so difficult to operate. Make any necessary repairs.

3. Consider an alternative design for the manhole cover over the emergency valve controls that could be easily opened by one man.

4. To assure the long-term stability of the dam, consideration should be given to repairing leaks in the dam and seepage at the right abutment by grouting. Also, any loose mortar should be replaced.

5. An investigation should be made to assess the hazard represented by the nearby seismically active fault. If a significant hazard is determined, then a seismic analysis should be performed, along with the seepage and stability analyses that are normally recommended for high hazard dams.

b. Operation and Maintenance Procedures

The following operation and maintenance procedures are recommended:

1. Regularly operate the emergency control valve to check its performance and to flush out any sediments in the intake area.

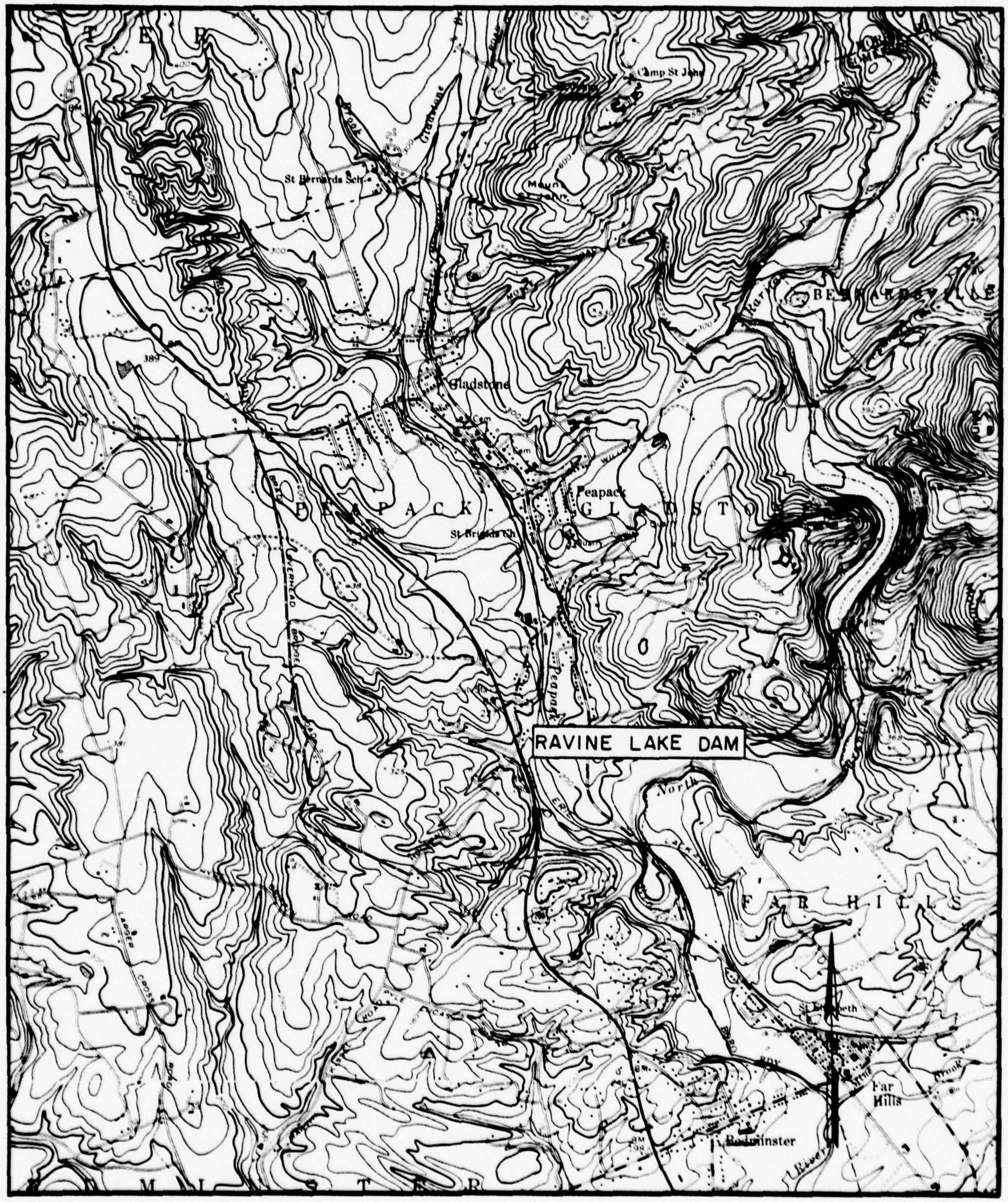
2. Inspect the dam annually, lowering the reservoir to below the spillway crest, and note the location and amount of leakage and seepage. At the same time measure the total seepage downstream of the dam, and if there is any significant increase in flow, immediate steps should be taken to determine the cause and to effect repairs. Also inspect the dam and abutments after any storm that results in overtopping.

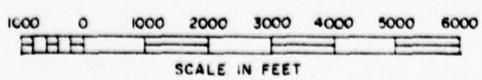
3. Perform timely maintenance work and keep records of such work.

4. Install survey markers on the top of the dam to monitor any future deflections of the dam.

5. Establish and implement a warning and evacuation plan to provide adequate warning to downstream residents. Also, surveillance of the dam should be provided during periods of heavy precipitation.

PLATE 1

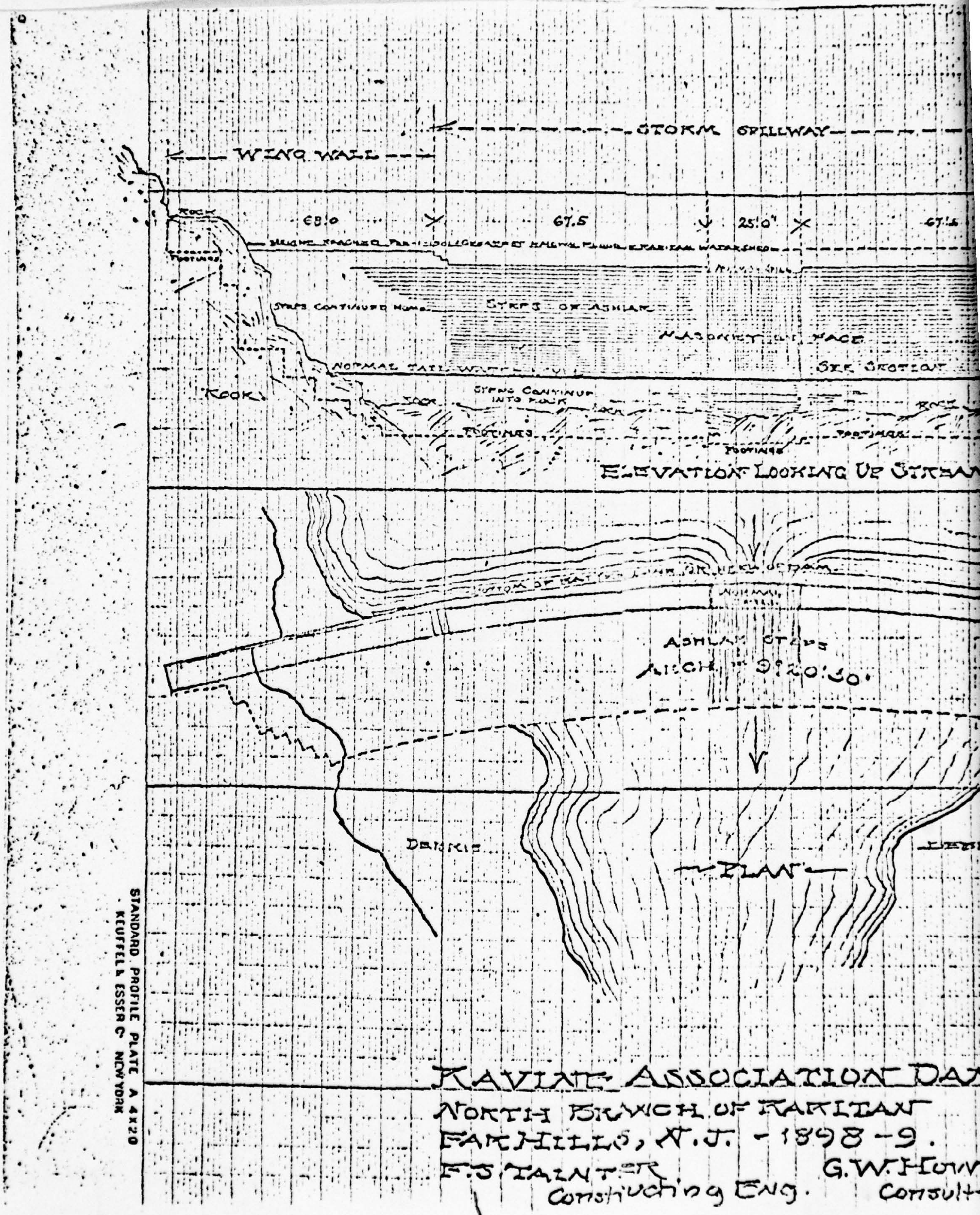




AREA LOCATION

VICINITY MAP

JENNY - LEEDSHILL JANUARY 1979


STORM SPILLWAY
WING WALL
ROCK
68.0
67.5
25.0"
FOOTINGS
STEPS OF ASHLAR
NORMAL TAIL WATER
ROCK
STEPS CONTINUE INTO ROCK
FOOTINGS
ELEVATION LOOKING UP STREAM
ASHLAR STEPS
DEBRIS
PLAN
RARITAN ASSOCIATION DAM
NORTH BRANCH OF RARITAN
FAR HILLS, N.J. - 1898-9.
F.S. TAINTER
Constructing Eng.
STANDARD PROFILE PLATE A 4X20
KEUFFEL & ESSER Co NEW YORK

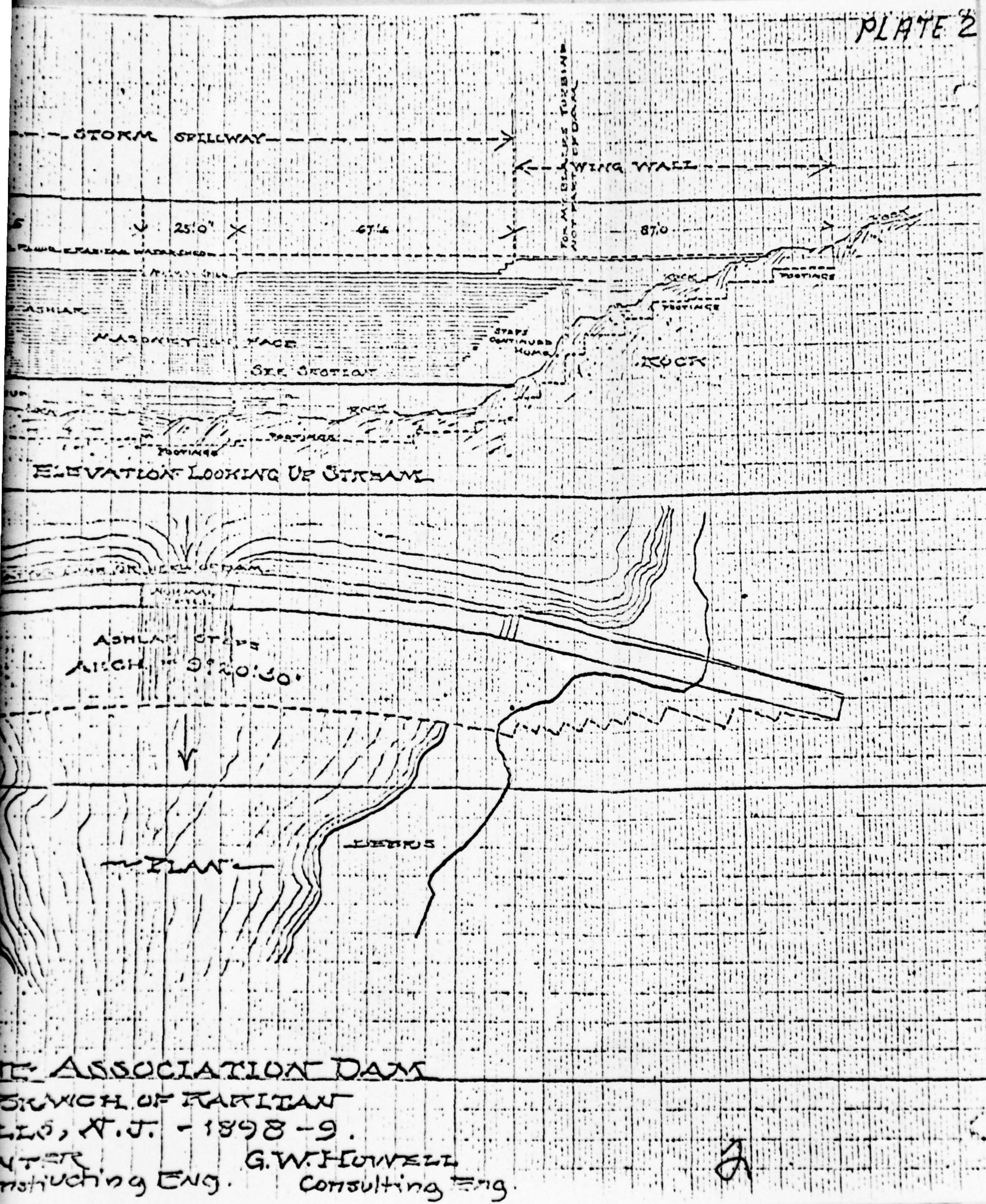
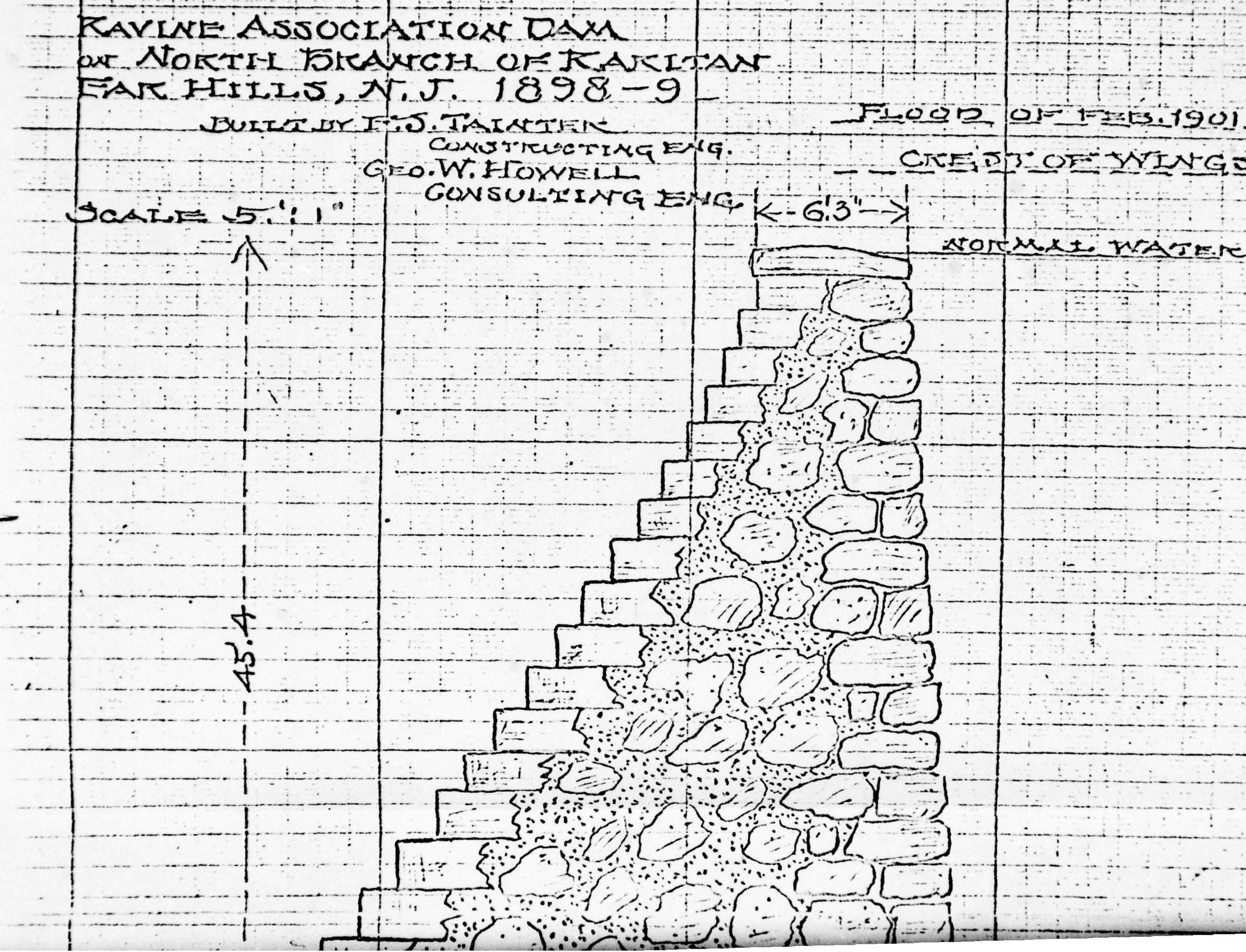
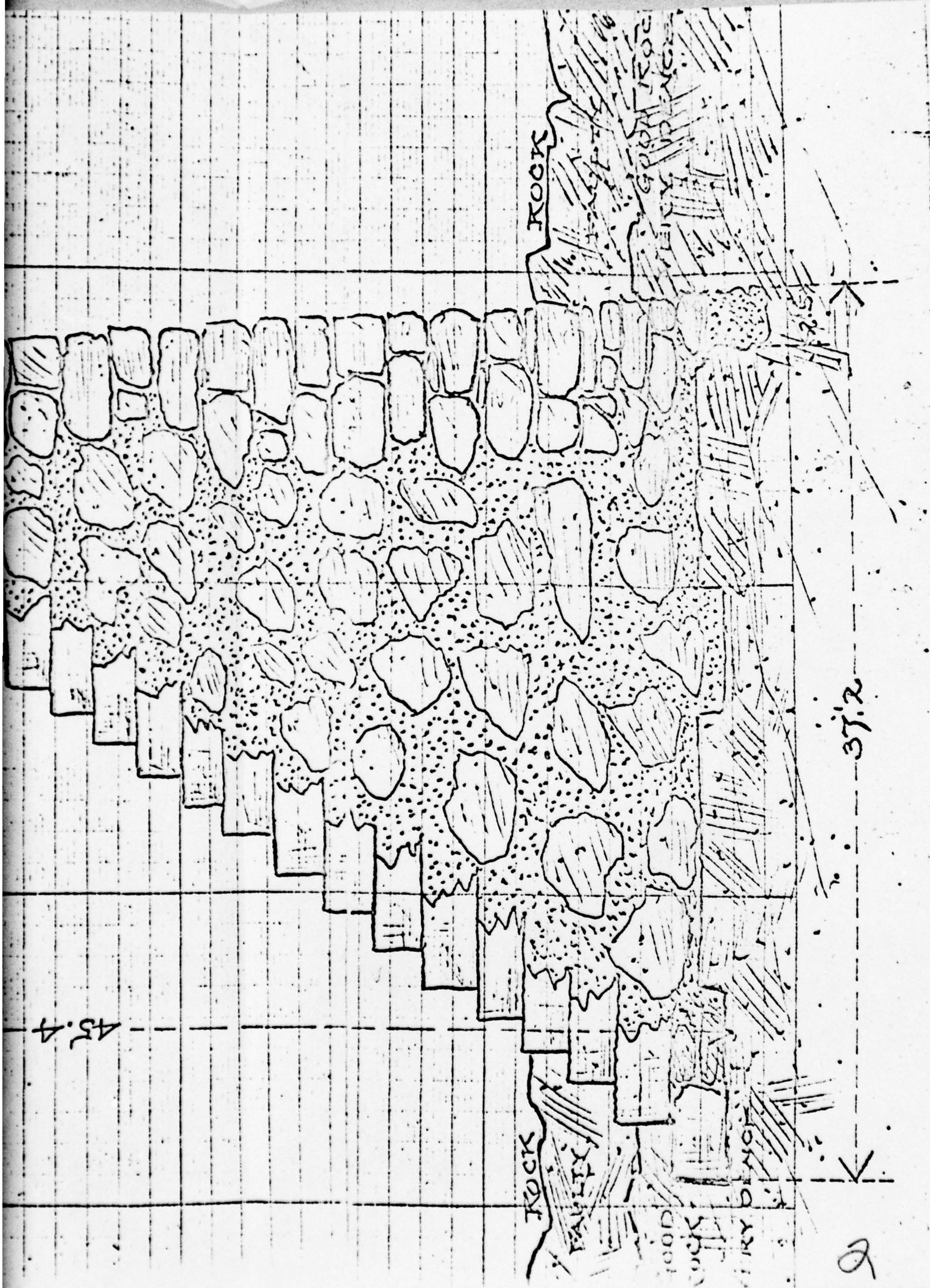


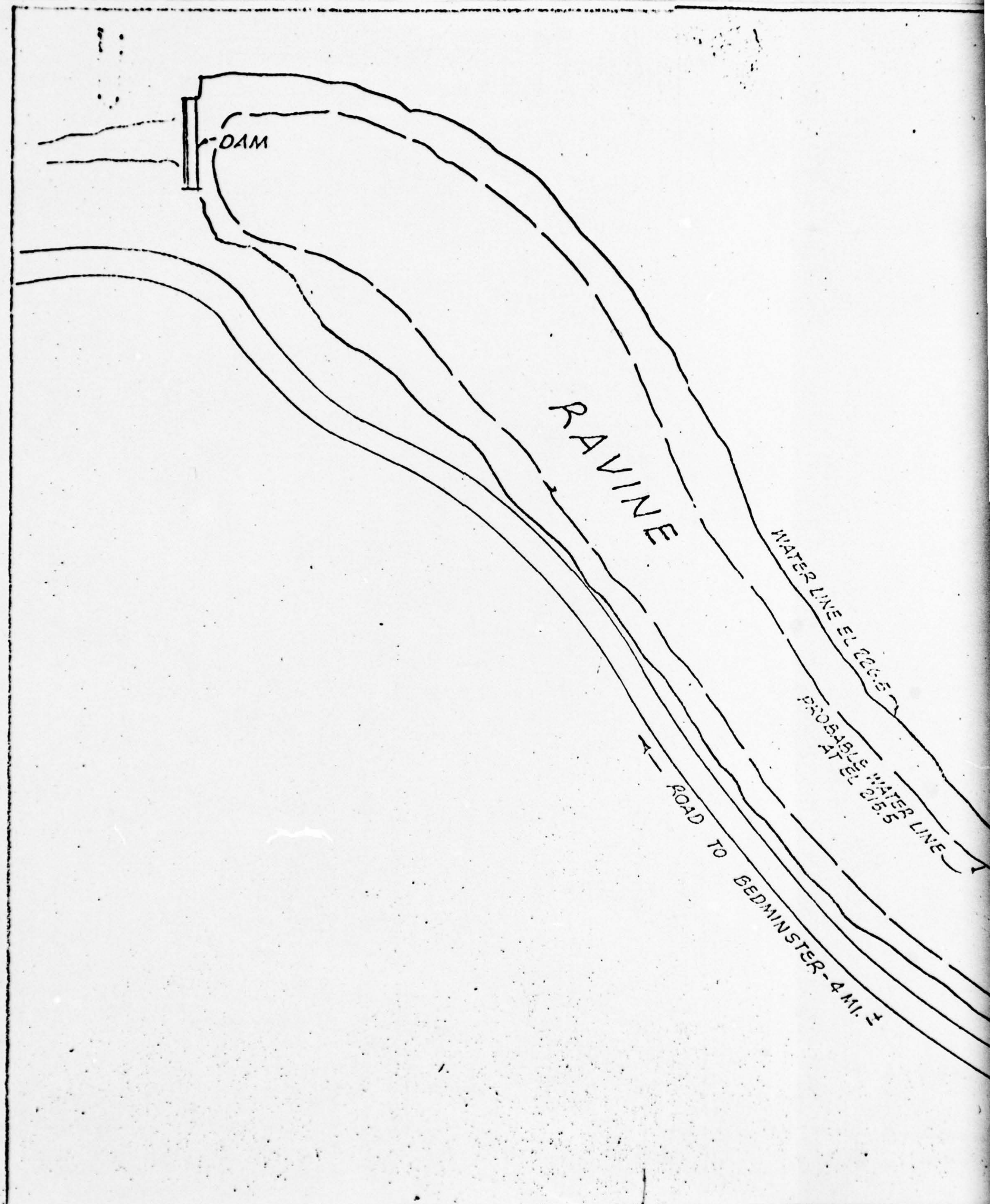
PLATE 2
STORM SPILLWAY
WING WALL
25'0"
87'0
ROCK
FOOTINGS
ASHLAR
STEPS CONTINUED
ELEVATION LOOKING UP STREAM
ASHLAR STEPS
PLAN
ASSOCIATION DAM
BRANCH OF RARITAN
LLS, N.J. - 1898-9.
G.W. HOWELL
nstructing Eng.
Consulting Eng

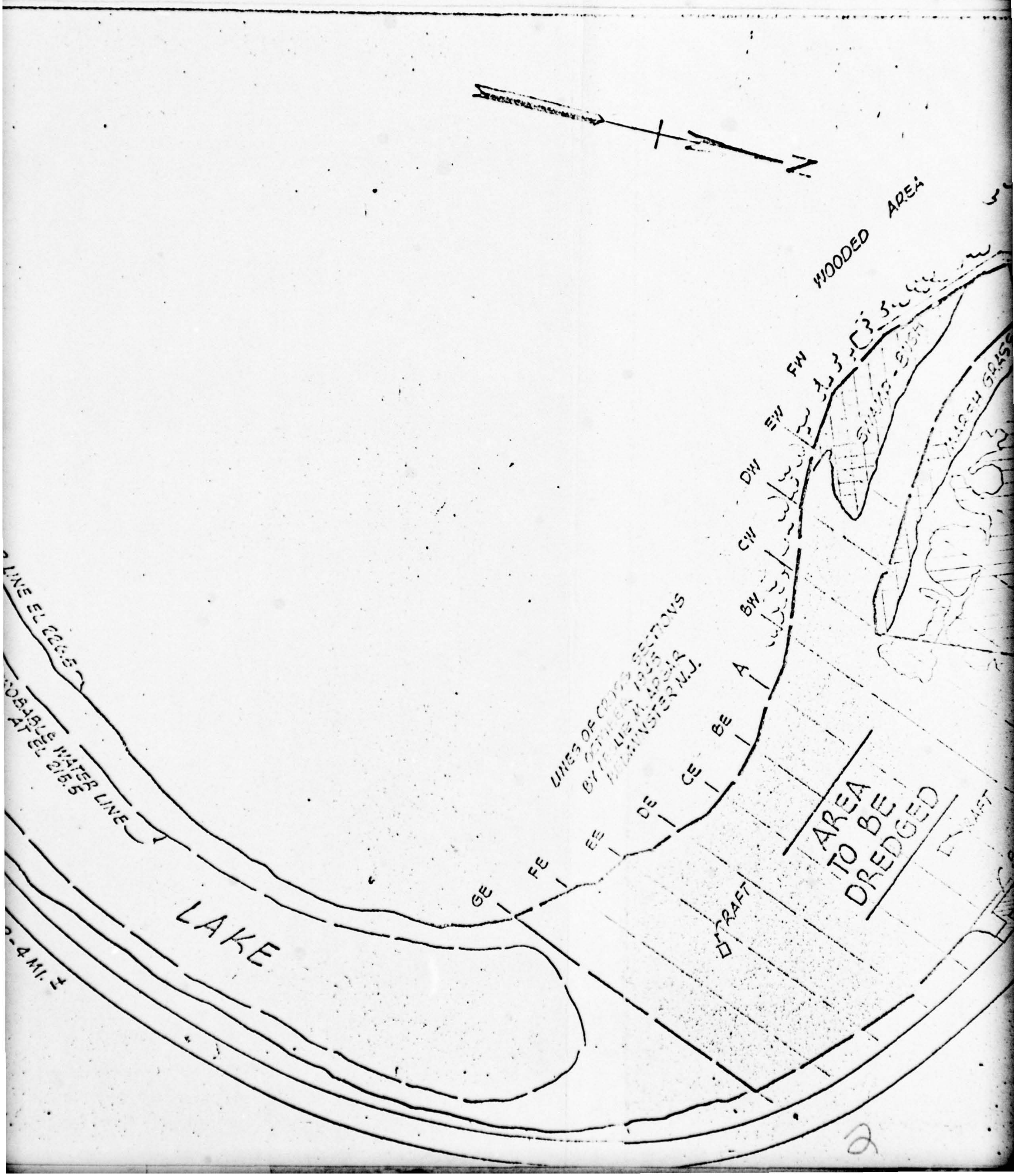


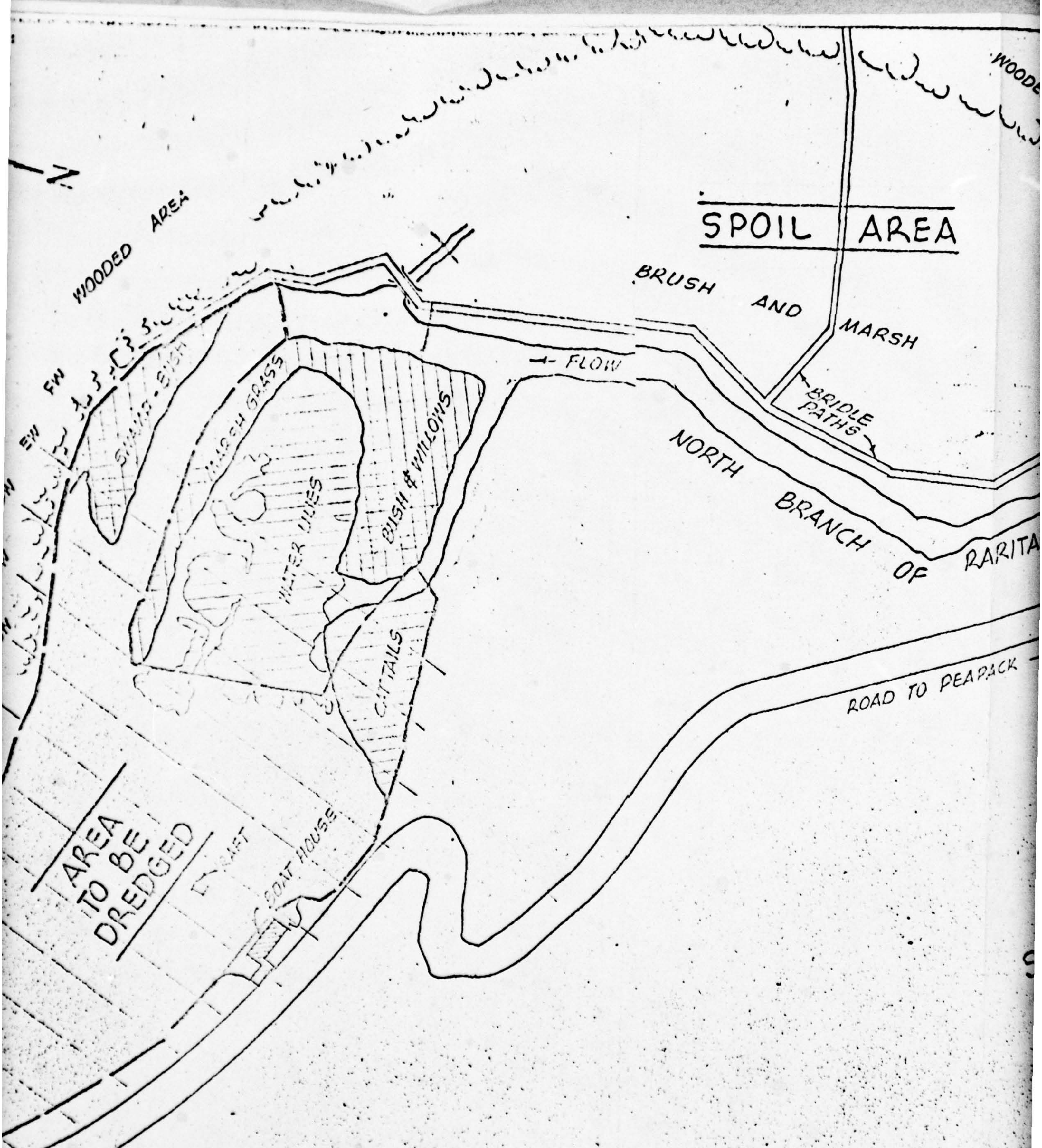
RAVINE ASSOCIATION DAM
ON NORTH BRANCH OF RARITAN
FAR HILLS, N.J. 1898-9
BUILT BY F.S. TAINTER
CONSTRUCTING ENG.
GEO. W. HOWELL
CONSULTING ENG.
SCALE 5':1"
FLOOD OF FEB. 1901
CREST OF WINGS
NORMAL WATER
6.3"
45.4

PLATE 3



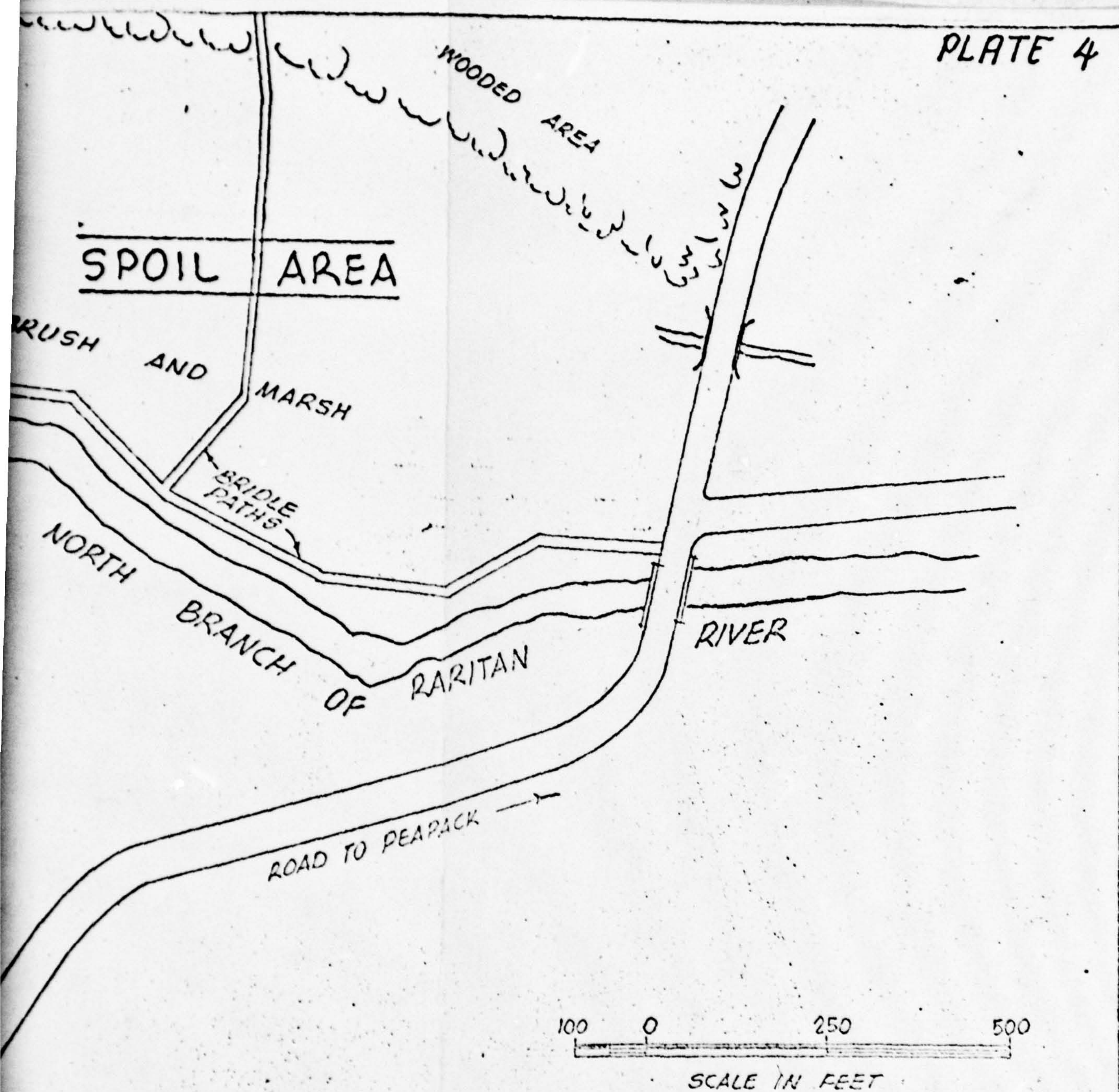

DAM
RAVINE
WATER LINE EL 226.5
PROBABLE WATER LINE AT EL 216.5
ROAD TO BEDMINSTER - 4 MI.±


WOODED AREA
MARSH GRASS
GE
FE
EE
DE
CE
BE
A
BW
CW
DW
EW
FW
AREA TO BE DREDGED
DRAFT
LAKE
PROBABLE WATER LINE AT EL 215.5



COMPILED FROM MAP BY LESLIE M. APGAR,
ENGINER AND SURVEYOR, OCT. 1945 & THE
GLADSTONE SHEET, ARMY MAP SERVICE, 1942.

PLATE 4



SOMERSET LAKE & GAME CLUB
MAP OF
RAVINE LAKE IMPROVEMENT
SHOWING
AREAS TO BE DREDGED
AND SPOIL AREA

TO ACCOMPANY REPORT BY
CLINTON L. BOGERT ASSOCIATES
CONSULTING ENGINEERS • NEW YORK, N. Y.
DATED - SEPTEMBER 30, 1949.

MAP BY LESLIE M. APGAR,
RVEYOR, OCT. 1945 & THE
ET, ARMY MAP SERVICE, 1942

3

4

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

Check List
Visual Inspection
Phase 1

Name Dam Ravine Lake Dam **County** Somerset **State** New Jersey Coordinator NJDEP

Coordinates: Lat. 40°42' 30"N
Long. 74°38' 13"W

Date(s) Inspection Dec. 4,1978 / Dec.21,1978 **Weather** Overcast **Temperature** 63°F

Pool Elevation at Time of Inspection 226.75 **M.S.L.** **Tailwater at Time of Inspection** 196.7 **M.S.L.**

Inspection Personnel:

(December 4, 1978)	(December 21, 1978)	(December 21, 1978)
R.G.Gaffin	R.J.Jenny	F. L. Panuzio
A.R. Slaughter	D. J. Lachel	A.L. Slaughter
P.L. Wagner		

P.L. Wagner **Recorder**

Owner Representative:
(December 14, 1978)

Charles Ashmun

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	3 small leaks through mortar on left side of dam near valve chamber. Some iron stains. Several small leaks on right side of dam 10 ft. from top, totaling about ½ gpm. Seepage from joint in abutment rock at junction of dam on right side 11 ft.	from top of dam, flow about 3 gpm. Iron stains on masonry. Seepage through right abutment probably traveling around dam through rock joints.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Left abutment bedrock obscured by soil cover. Right abutment is bedrock (granite) outcrop. Seepage at right abutment as noted above.	
DRAINS	None	
WATER PASSAGES	No flow through 48-inch emergency outlet or 6-inch water supply line. No seepage.	
FOUNDATION	Granite bedrock on right abutment extending to downstream toe. No bedrock observed on left side of dam. Foundation largely submerged or obscurred.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None observed. Concrete surfacing of wing walls in good condition.	
STRUCTURAL CRACKING	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT	No apparent misalignments	
MONOLITH JOINTS	Not applicable	
CONSTRUCTION JOINTS	Mortar was tested around valve chamber on left side and was found to be loose and joints open. Some seepage as noted above.	Joints should be tested, grouted, and rammed with stiff cement mortar.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Not applicable	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Not applicable	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Not applicable	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Not applicable	
RIPRAP FAILURES	Not applicable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Not applicable	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Not applicable	
ANY NOTICEABLE SEEPAGE	Not applicable	
STAFF GAGE AND RECORDER	Not applicable	
DRAINS	Not applicable	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable	
INTAKE STRUCTURE	Wooden log boom above intake on left side of dam. Intake submerged.	
OUTLET STRUCTURE	Valve in masonry box on downstream side of dam with 6-in. C.I. pipe. Pipe is buried downstream except for short section of 12-in. pipe, presumably leading into brick pumphouse 75 yds. downstream.	Several lengths of abandoned 4-in. C.I. pipe lying about.
OUTLET CHANNEL	None	
EMERGENCY GATE	48-inch concrete-lined outlet at base of dam on right side. Manhole above on top of dam. Box has 8-in. thick granite slab cover with 4-in. hole in center. Manhole filled with water to reservoir level.	Access to right side of dam is difficult. Manhole cover would be difficult to remove. Manhole should be dewatered.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Spillway sill appears to be in good condition, as judged by uniform flow of water over it.	
APPROACH CHANNEL	Reservoir is approach channel.	
DISCHARGE CHANNEL	Stepped downstream face of dam and a natural stilling pool at toe of dam extending about 200 ft. downstream. Bridge further downstream.	
BRIDGE AND PIERS	None	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable	
APPROACH CHANNEL	Not applicable	
DISCHARGE CHANNEL	Not applicable	
BRIDGE AND PIERS	Not applicable	
GATES AND OPERATION EQUIPMENT	Not applicable	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Staff gage on left side of dam. U.S.G.S. gaging station just upstream.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very steep, wooded. Potential for debris. No indication of slides.	
SEDIMENTATION	Minor sediment at each abutment.	Previous reports indicate heavy siltation in reservoir.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Stilling pool extends about 200 ft. downstream from dam. Natural channel meandering, with fairly steep gradient. Wooded area. Bridge ¼ mile downstream. Pumphouse 75 yds. downstream on left bank.	
SLOPES	Flood channel about 200 ft. wide, with very steep slopes on right bank and moderate slopes on left bank.	
APPROXIMATE NO. OF HOMES AND POPULATION	6 houses in flood plain immediately downstream. Others in communities further downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	"Ravine Association Dam, North Branch of Raritan, Far Hills, N.J., 1898-9" Plan and Elevation (See Plate 2). See also plan and elevation included in H. de B. Parsons report in Appendix D.
REGIONAL VICINITY MAP	U.S.G.S. topographic maps (See Plate 1).
CONSTRUCTION HISTORY	Some data available from previous inspection reports (See Appendix D).
TYPICAL SECTIONS OF DAM	"Ravine Association Dam on North Branch of Raritan, Far Hills, N.J., 1898-9" Section of Dam at Spillway, Scale 1"=5'0" (See Plate 3).
HYDROLOGIC/HYDRAULIC DATA	Reservoir area obtained from "Somerset Lake and Game Club, Map of Ravine Lake Improvement, Showing Areas to be Dredged and Spoil Area, to Accompany Report by Clinton L. Bogert Associates" Sept. 30, 1949, Scale 1"=200' (See Plate 4).
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	None available
RAINFALL/RESERVOIR RECORDS	Records of gaging station at dam are presumable available at U.S.G.S, Surface Water Branch, Trenton, N.J.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	No recent data. Plans and sections (Plates 2 and 3) were apparently made just after construction.
BORROW SOURCES	Not applicable

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
SPILLWAY-PLAN	
-SECTIONS	See "Typical Sections of Dam"
-DETAILS	None available
OPERATING EQUIPMENT PLANS & DETAILS	None available
MONITORING SYSTEMS	None
MODIFICATIONS	None reported
HIGH POOL RECORDS	Records of U.S.G.S. gaging station at dam are available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	See Maintenance Operation Records.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
MAINTENANCE OPERATION RECORDS	"Inspection Report - Ravine Lake Dam" by Apgar Associates, August 31, 1973. State inspection reports dated June 4, 1951, March 16, 1950, and December 6,1928. "Report on Dam near Bernardsville, N.J." by H. de B. Parsons, Consulting Engineers, June 28, 1915. All of above included in Appendix D.

APPENDIX B

PHOTOGRAPHS

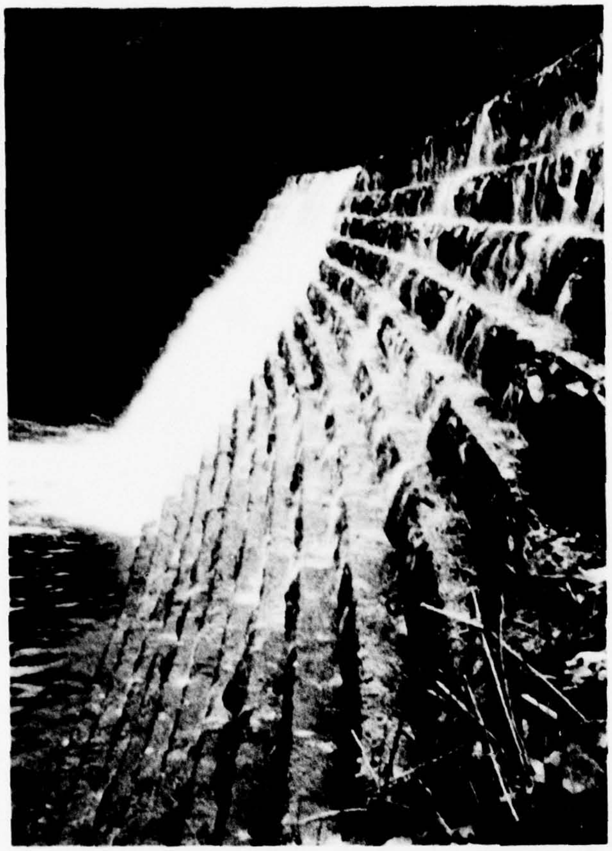


Photo 1 - Downstream face of dam looking west.
(December 4, 1978)

Photo 2 - Leak (arrow) through mortar joint near right abutment, about 10 feet below crest.
(December 4, 1978)

Photo 3 - Seepage at right abutment causing iron-stained mineral deposits. (December 4, 1978)

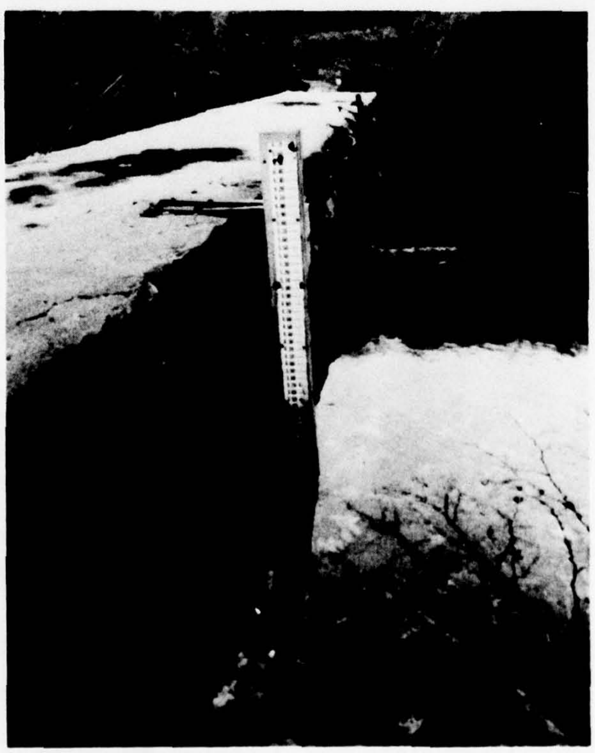


Photo 4 - Upstream left side of dam, showing uncoursed rubble masonry, staff gage and log boom above intake structure. (December 4, 1978)

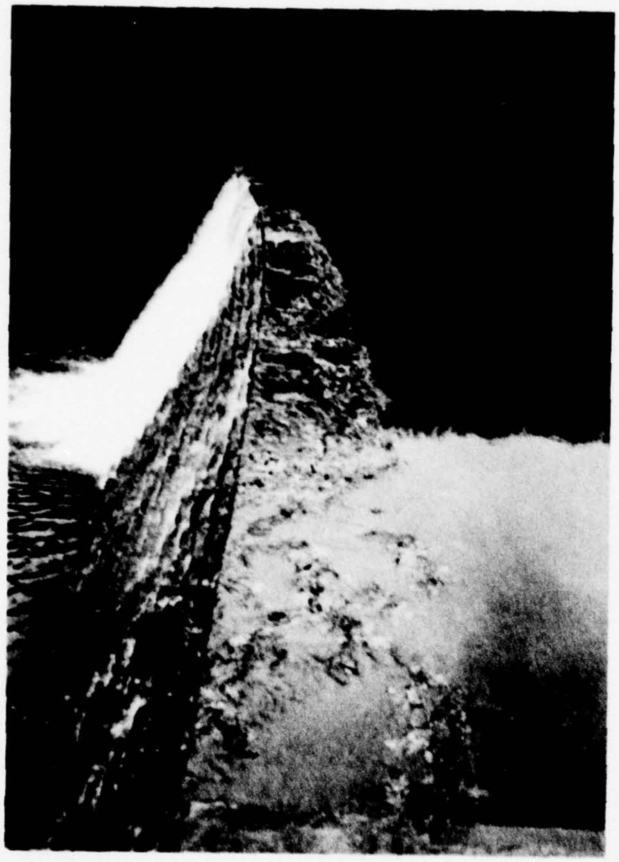


Photo 5 - View of spillway looking west. (December 4, 1978)

Photo 6 - Valve chamber for 6-inch outlet on left side of dam. (December 4, 1978)

Photo 7 - 48-inch emergency outlet on right side of dam. (December 4, 1978)

Photo 8 - Granite slab cover over manhole housing emergency outlet valve. (December 4, 1978)

Photo 9 - Reservoir, looking toward west bank from dam. (December 4, 1978)

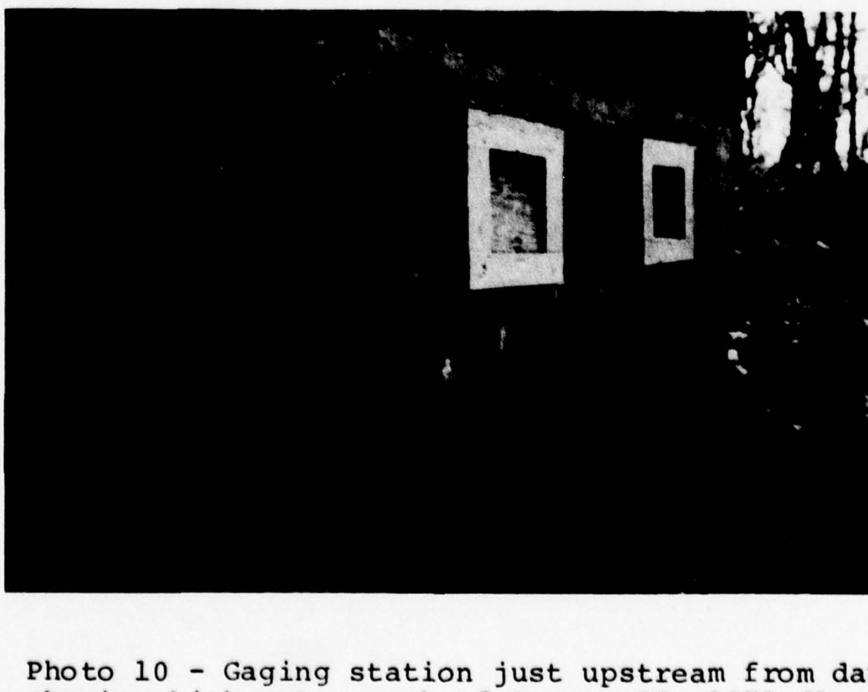


Photo 10 - Gaging station just upstream from dam, showing high water mark of August 28, 1971 flood. (December 4, 1978)

Photo 11 - Stilling pool and downstream channel. Pump house on left bank. (December 4, 1978)

Photo 12 - Bridge and houses ¼ mile downstream. (December 4, 1978)

APPENDIX C

REGIONAL GEOLOGY - HIGHLANDS PROVINCE

REGIONAL GEOLOGY - HIGHLANDS PROVINCE

Physiography

The New Jersey Highlands extend northeast-southwest across the state from the New York border to the Delaware River. Included in the province are the northwest portions of Hunterdon, Passaic and Morris Counties and the southeastern portions of Warren and Sussex Counties. This province lies between the Appalachian Ridge and Valley Province to the northwest and the Piedmont Lowlands Province to the southeast (See Figure C-1) and is part of the larger New England Physiographic Province.

The Highlands are characterized by rounded and flat-topped northeast-southwest ridges and mountains up to 1,400 feet high separated by narrow valleys. The orientation of the valleys is usually, but not always, controlled by the underlying geologic structure.

Bedrock

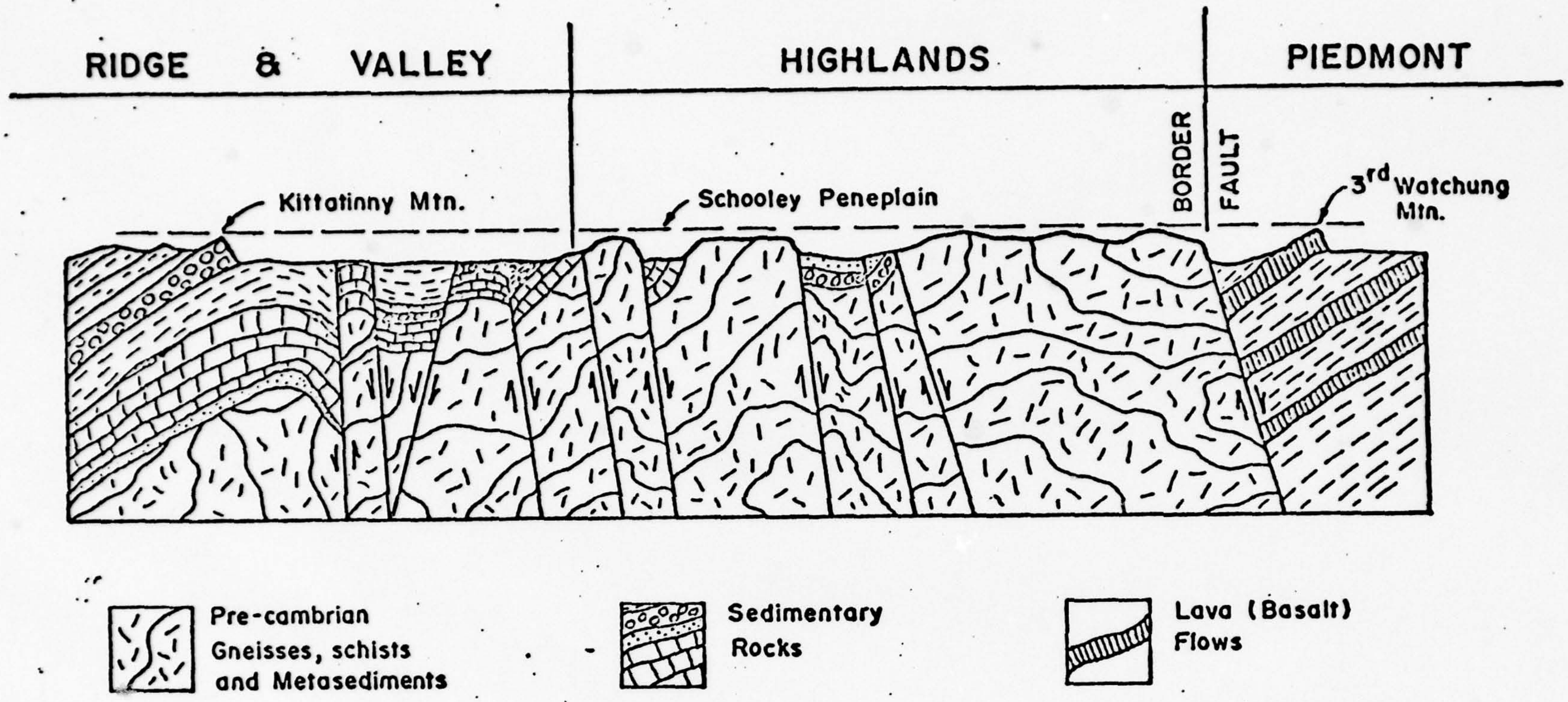
Bedrock of the region is predominently Precambrian gneisses, schists and metasediments. Some sedimentary rocks, typically sandstones, shales and conglomerate have been infolded and infaulted into the valley bottoms.

The regional geologic structure reflects the very old age of bedrock. A number of regional faults cross the area in a northeast-southwest direction. The Ramapo Fault scarp, forming the eastern border of the province, is more than 30 miles long. Faults also control many of the river valley orientations.

Mountain crests slope uniformly from northwest to southwest, a direct result of the fact that the entire area was once part of the now dissected Schooley peneplain.

Overburden

Much of the province was covered by the Pleistocene age Wisconsin glacier. The glacier stripped most of the existing overburden and weathered rock and uncovered the numerous hard bedrock knobs and ridges seen throughout the province. Most of the side-slopes in the area are covered with heavy boulder tills (ground moraine), while glacial outwash and recent alluvium cover the valleys. South of the terminal moraine extending from Morristown to Belvidere, scattered remnants of earlier stages of glaciation (Illinoian and Kansan) have deposited ground moraine (glacial tills) over the bedrock. In the valleys and over some of the ground moraine, recent and glacio-fluvial alluviums have been deposited.



SCHEMATIC CROSS-SECTION OF
NEW JERSEY HIGHLANDS
PHYSIOGRAPHIC PROVINCE
(AFTER WOLFE, 1977)

JENNY/LEEDSHILL
JANUARY 1979

FIGURE C-1

APPENDIX D

PREVIOUS INSPECTION REPORTS:

AGPAR ASSOCIATES, 1973

STATE OF NEW JERSEY, 1951, 1950, 1928

H. de B. PARSONS, 1915

APGAR ASSOCIATES
CONSULTING ENGINEERS & LAND SURVEYORS

DEMUN PLACE
FAR HILLS, NEW JERSEY 07931
201-234-0416

HEINRICH PADE, L.S. & P.P.
ROBERT H. FOX, P.E.
THADDEUS F. HOLMAN, L.S.

ERNEST C. HIESENER, P.E.
WAYNE F. HOLMAN, L.S.

SOIL AND FOUNDATION ENGINEERING
DAMS AND WATER SUPPLY
WATER RESOURCES PLANNING
SEWERAGE, DRAINAGE & FLOOD CONTROL
LAND SUBDIVISIONS AND SURVEYS
STREETS AND HIGHWAYS
MUNICIPAL ENGINEERING
PROFESSIONAL PLANNING

August 31, 1973

Somerset Lake and Game Club
Box 351
Far Hills, New Jersey 07931

Re: Inspection Report - Ravine Lake Dam

Gentlemen:

On June 11, 1973 we completed our inspection of the Ravine Lake Dam. The water surface elevation had been lowered to approximately 2.9 feet below the crest of the spillway. The valve, which had been opened during the preceding days, was closed at 9:30 A.M. by employees of H. W. Alward, Inc.

Valve Operation

Operation of the valve was very difficult. At least two men, using long handle wrenches or bars, were required to develop sufficient torque to rotate the valve stem. Even after twenty or thirty rotations, its operation remained very difficult. When the valve was closed, it seated properly without leakage.

Manhole Leakage

The manhole housing the valve was filled with water, apparently to the same level as the lake. The manhole was dewatered to nearly its full depth by use of a submersible pump powered by compressed air. Leakage into the manhole was rapid, and after about an hour it was filled with water again. We could not locate any drains on the downstream face of the dam to provide an outlet for this water.

Stability of Dam

We examined the dam and each abutment for signs of instability. We could find no cracks, no indication of movement, nor any sign of instability whatsoever. There was no evidence of undercutting the downstream toe nor of erosion at the base of the abutments. There was some minor erosion of the overburden on the east abutment near the top of the dam. It was reported that this occurred during the storm of August 28, 1971.

or if at least a portion of it is coming from the lake through a crack in the abutment. Because of its strong smell it would appear that it is mostly sewage effluent, flowing through a crack in the rock, from some point at a higher elevation. However, the rate of flow did appear to be affected by a change in the lake level. I believe it is important to recognize the possibility of sewage outflow upstream from the dam, directly into the lake.

5. After the valve had been closed for about two hours we observed the rate of flow in the stream about fifty feet below the dam. We estimated the rate to be about fifty gallons per minute. Eliminating the estimated flow from the west abutment (fifteen gallons per minute) it would appear that the total leakage through, around, and under the dam is about 35 gallons per minute. This is a relatively low rate of flow. It would appear that underseepage is very minor.

6. There are minor leaks beneath and around the coping stones on the top of the spillway at several locations.

RECOMMENDATIONS

1. Remove and replace loose mortar around the coping stones on the top of the dam.

2. Remove and replace loose mortar on the upstream face of the dam near the water line.

3. Remove and replace loose mortar at various locations on the downstream face of the dam as may be necessary.

4. Place and compact fill on the east abutment where it was washed out during the 1971 storm. Topsoil and seed.

5. Remove debris and organic material on each side of the upstream face of the dam.

6. Lower the lake level to an elevation about seven tiers below the top of the dam. Inspect for leakage and make necessary repairs in dam near west end of weir. Although this leak is not serious, it would be best to eliminate it.

7. With the lake lowered, make whatever repairs may appear necessary to the penstock, valve, and valve box.

8. Prior to lowering the lake, again try to dewater the manhole for the main valve using a larger pump. Observe and note locations of significant leakage through the manhole walls. Later, with the lake lowered, make necessary repairs to the manhole.

9. Locate and clean manhole drains.

10. Observe changes in the rate of flow through leak in west abutment (sewage odor) as the lake is lowered.

11. Report this apparent sewage outflow to the Peapack and Gladstone Board of Health and the New Jersey Department of Environmental Protection.

SUMMARY

It is our opinion that the dam is stable and generally in good condition. Leakage is minor and does not affect the safety of the structure. We do suggest that you direct your attention to the above mentioned recommendations.

Very truly yours,

APGAR ASSOCIATES

Robert H. Fox, P.E.

RHF/nh

State of New Jersey
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
CHARLES R. ERDMAN, JR., COMMISSIONER

DIVISION OF
WATER POLICY AND SUPPLY
H. T. CRITCHLOW, DIRECTOR

520 E. State St.
~~[illegible]~~
TRENTON K 9

June 4, 1951

Mr. Clarence V. S. Mitchell, Director
Ravine Association
c/o Choate, Mitchell & Ely
41 Broad Street
New York 4, N. Y.

Re: Ravine Lake
Dam No. 25-54 - Somerset County

Dear Sir:

In accordance with your letter of May 10, 1951 an inspection of the dam at Ravine Lake was made by an engineering representative of this Division on May 24, 1951.

The inspection disclosed that the dam was in a sound structural condition with no evidence of leakage under or around the dam.

Yours very truly,

H. T. Critchlow

H. T. Critchlow
Director and Chief Engineer

Dam

State of New Jersey
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
CHARLES R. ERDMAN, JR., COMMISSIONER

DIVISION OF WATER POLICY AND SUPPLY

28 WEST STATE STREET
TRENTON 8

March 16, 1950

Mr. Clarence V. S. Mitchell, Secretary
The Ravine Association
c/o Choate, Mitchell & Ely
41 Broad Street
New York 4, New York

Re: Ravine Lake, Dam No. 25-54, Somerset County

Dear Sir:

Your letter of February 27, 1950 addressed to the Division of Fish and Game has been referred to this office as a matter pertaining to this Division.

Please be advised that an inspection of the dam at Ravine Lake was made on October 25, 1949 by engineering representatives of this Division. The inspection disclosed that the dam appears to be in first-class structural condition. There is no evidence of leakage through or under the dam.

Yours very truly,

H. T. Critchlow

H. T. Critchlow
Director and Chief Engineer

STATE OF NEW JERSEY

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

STATE OFFICE BUILDING, TRENTON

THE DEPARTMENT OF CONSERVATION AND DEVELOPMENT REPRESENTS THE INTERESTS OF THE PEOPLE OF NEW JERSEY IN GEOLOGY, FORESTRY, POTABLE WATERS, IDLE LANDS AND ALL UNDEVELOPED RESOURCES. IT PUBLISHES MAPS AND DETAILED INFORMATION, AND OFFERS ADVICE ABOUT MINERALS, SOILS, STREAMS, WELLS, FORESTS, SHADE TREES. IT CONDUCTS THE STATE TESTING LABORATORY, MUSEUM, FOREST FIRE SERVICE AND LAND REGISTRY.

RECEIVED FEB 8 1929 WM. H. PAGE

December 6, 1928.

Colonel F. S. Tainter,
Bernardsville, N. J.

Dear Colonel Tainter:

Your letter of December 5, together with blue print showing the results of soundings below the Ravine Lake dam, is at hand.

We take pleasure in enclosing a copy of a report upon our inspection of the structure. We are glad to congratulate you upon the excellence of both the design and construction of this dam and are gratified by its excellent present condition.

We have advised Mr. Hartwell that the pond has been refilled.

Yours very truly,

DEPT OF CONSERVATION AND DEVELOPMENT

John N. Brooks.

John N. Brooks
Hydraulic Engineer.

JNB:mrh

The report is on file with the Ravine association, where it may be seen by all interested persons.

F. S. Tainter

The report is on file with the Ravine association, where it may be seen by all interested persons

F.S. TAINTER

File - Dams Somerset Co.

STATE OF NEW JERSEY

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

STATE OFFICE BUILDING, TRENTON

THE DEPARTMENT OF CONSERVATION AND DEVELOPMENT REPRESENTS THE INTERESTS OF THE PEOPLE OF NEW JERSEY IN GEOLOGY, FORESTRY, POTABLE WATERS, IDLE LANDS AND ALL UNDEVELOPED RESOURCES. IT PUBLISHES MAPS AND DETAILED INFORMATION, AND OFFERS ADVICE ABOUT MINERALS, SOILS, STREAMS, WELLS, FORESTS, SHADE TREES. IT CONDUCTS THE STATE TESTING LABORATORY, MUSEUM, FOREST FIRE SERVICE AND LAND REGISTRY.

HL

3490

Report on Dam Inspection.

RAVINE LAKE

Dam No. 25-54

Location 25.22.1.9.2

At the request of Colonel F. S. Tainter, inspections were made on November 20 and November 24, 1928 of the Somerset Lake and Game Club dam on the North Branch of Raritan River near Far Hills, Somerset County, New Jersey. This dam is known as Ravine Lake and was constructed under Colonel Tainter's direction and completed in 1898. The purpose of the inspections was to determine the condition of the structure.

The dam is a gravity section masonry structure, curved in plan and founded on ledge rock. The faces are of dimension stone laid in cement mortar, the core is reported to be of cyclopean concrete. The upstream face is vertical, the downstream face stepped.

The dam is 35 feet high and 271 feet long; 163 feet of the top is depressed from 3.5 to 4 feet, forming a spillway but the entire structure is reported to have been overtopped to a depth of 18 inches without damage.

On the morning of November 20, 1928, the 48-inch blow-off gate valve at the right end of the dam was slowly opened to full opening. This valve is a water works type bronze mounted cast iron gate valve set within a manhole in the dam and operated by an extension stem reaching the top of the dam. The valve operated perfectly. When the valve was first opened a small amount of black silt was discharged and during the first few minutes of full open discharge black silt was discharged intermittantly but the total amount was small.

Upon the first view of the dam with 0.5 foot of water passing over the lowest portion of the spillway, two small leaks were noted. The first leak comes through the masonry four feet below the top of dam at the intersection of the downstream face with the right bank. Leakage also appears to come from the ledge rock in the right bank down to a point 12 feet below the top of dam. The water discharged

is perfectly clear and small in amount. This leak is insignificant and does not endanger the stability of the dam. The second leak appears as seepage, leaving an iron stain on the face of the retaining wall at the pump house penstock at left end of the dam. It is insignificant and may come from the penstock.

When the pond level had been drawn below the spillway and the downstream face of the dam had dried off, a careful examination was made of the masonry. No leaks were found and the mortar in masonry joints was found to be hard and sound. Grass and weeds have grown out on the steps of the downstream face at both ends of the dam. This material should be removed and the joints behind it be raked out and repointed.

On November 24, 1928, when the second inspection was made, the pond level had been drawn down to 12 feet below the spillway and the upstream face of the dam was examined. The pointing of the masonry below the water line was found to be in excellent condition. The mortar is hard and sound and can be broken out with a hammer only with difficulty.

At the flow line and on the face of the parapet wall above the flow line there are places where the pointing mortar has become loosened and a few places where it has fallen out. The upper five feet of the dam should be gone over carefully with the hammer next spring and all loose pointing mortar be removed and the masonry joints be repointed.

The leaks noted on November 20 when the pond was full were stopped by dropping the water level 12 feet.

The pool at the downstream toe of the dam could not be unwatered conveniently and on November 24 Colonel Tainter's men were making a careful survey of this pool by means of soundings. This work was done at the writer's request. The results are now at hand and show the lowest elevation of the rock bottom of the pool to be 177. The base of dam masonry is reported to be at elevation 170 ±. There is no evidence of undercutting of the dam foundation nor of erosion of the ledge rock at the downstream toe of the dam. The normal depth of water in the pool is 7 feet providing a satisfactory cushion to receive heavy flows over the spillway.

The results of these inspections of the Ravine Lake dam show that the structure was well planned and admirably constructed. The present condition of the structure is excellent and with the minor repairs in the way of re-

pointing above mentioned the dam should remain unimpaired in density and stability for many years.

John N. Brooks

John N. Brooks,
Hydraulic Engineer.

Trenton, N. J.,
December 6, 1928.

Report reviewed by

H. T. Critchlow,
Chief, Division of Waters.

REPORT ON DAM

NEAR BERNARDSVILLE, N. J.

H. de B. PARSONS.
[illegible] WILLIAM STREET,
NEW YORK.

H. de B. PARSONS
CONSULTING ENGINEER
22 WILLIAM STREET, NEW YORK
CABLE ADDRESS, [illegible]

REPORT ON DAM

NEAR BERNARDSVILLE, N. J.

28th June, 1915.

The Ravine Association,
c/o Percy R. Pyne, Esq.,
30 Pine Street,
New York City.

Gentlemen:-

In compliance with the request of Mr. Percy R. Pyne, I have had an examination made of your Dam by my Assistant Engineer, Mr. David C. Johnson, on 18th June, 1915, and beg leave to report as follows.

DESCRIPTION.

The Dam is located across the North Branch of the Raritan River and was constructed about sixteen years ago for the purpose of impounding a lake for scenic and other reasons. As surveys or drawings for the Dam were not submitted to us, the measurements mentioned below are only approximate. These measurements were made on the Dam under some difficulty at the time of its examination.

The Dam is about 276 feet on the crest. There is a spillway at the center 25 feet wide, with its crest 6 inches lower than the crest of the main Dam. At each end, the Dam is built up about 3 feet 6 inches above the main crest. The Dam is about 34 feet 6 inches in height, as measured to the crest. The crest is about 27 feet 8 inches above tailwater, and about 22 feet above the mud deposit against the upstream face. The width of the Dam at the base is about 25 feet 10 inches. In plan, the Dam is arched to a radius of 500 feet.

The Dam is constructed of ashlar masonry, with cut joints and rock faces. The upstream face is approximately vertical, and the downstream face is built in steps varying from 24 inches in height at the toe to 17 inches at the crest. The stone is a species of gray granite.

The Dam is not built in exact accordance with the specifications which you showed me dated 28th May, 1898, although the stone-work appears to follow the specifications very closely. It is, therefore, probable that the interior of the Dam is built of rubble concrete and that the ashlar masonry is only a facing.

The Dam has been founded on an igneous rock, pinkish, coarse, and granitic in character. This rock is probably a dike formation, and is in layers with cleavage-planes at irregular angles. It is to be presumed that the Dam is well founded on the rock. The rock is strong for foundation purposes. The seams are its chief fault, as water might pass

through them unless they have been well stopped during the construction of the Dam.

The plan, elevation, and cross-section are shown on the accompanying diagrams, and the structure is well illustrated by the photographs annexed hereto.

MAXIMUM FLOW OVER DAM.

The drainage area above the Dam is 24.4 square miles. Assuming a rain-fall of 9.4 inches in 24 hours, with a run-off of 90 per cent., there would be a flow over the Dam of 5550 cubic feet per second. This flow would correspond to 5 feet of water flowing over the main crest. I have calculated the strength of the structure as a gravity section, assuming a height of water of 5 feet 6 inches above the main crest. This calculation shows that the Dam is stable. Undoubtedly, the arched shape does materially add to the stability of the structure, and it is to be presumed that the original design took consideration of this fact.

LEAKAGE.

There is a leak on the west bank near the 48-inch pipe through the Dam. This leak has an approximate flowage of three gallons per minute. The water appears to issue from a fissure in the abuttment rock, and probably is seeping through a seam which the builders of the Dam failed to properly close. As the rock is firm, I do not consider that this leak creates any element of danger and it does not give indication of liability to increase.

On the east bank there is a leak through the lower retaining wall. The water is seeping through two places in the joints of the retaining wall, with a flowage of about four gallons per minute. It was not possible to trace the origin of this leak, that is, whether the water came through a fissure in the rock under the Dam, or through the masonry of the Dam. There is no indication that this leak will create damage beyond the throwing of a portion of the retaining wall out of position due to the action of frost.

There are leaks through the joint beneath the coping stones on the crest of the Dam. These leaks appear to come through defects in bonding the coping stones to the masonry of the Dam, owing to the difficulty of making an unbroken horizontal joint water tight. Probably expansion and contraction have aided to break the jointing bond of the cement.

The main body of the Dam appears reasonably tight, although there are a few places where water seeps through. These leaks are difficult to trace on account of the water trickling down from the joint beneath the coping stones, mentioned just above.

CONCLUSIONS.

It is my opinion that the Dam is stable, and is sufficiently strong to resist the water pressure that might be brought against it by even extraordinary freshets.

We were informed that it is your practice to keep

the ice cut and not permit the water to freeze solid back of the crest of the Dam. This is a good precaution and one to be approved.

RECOMMENDATIONS.

I would suggest, when the water in the lake is drawn off, that the pointing on the upstream face be examined, and that all places, which show evidence of being open, be carefully grouted and rammed with cement mortar.

Also, that especial attention be given to the joint beneath the coping stones, so as to prevent water from flowing through.

Also, that the rock abuttments be examined and any seams or fissures in the rock be stopped with hydraulic cement mortar.

I do not consider that the lake need be drawn off, at the present time, solely for this purpose, but rather that advantage be taken of the opportunity when the lake is drawn off for any reason.

Yours respectfully,

H. de B. Parsons

AD-A069 546 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. RAVINE LAKE DAM (NJ 00362), RARITA--ETC(U)
MAY 79 R J JENNY DACW61-78-C-0124

UNCLASSIFIED NL

2 OF 2

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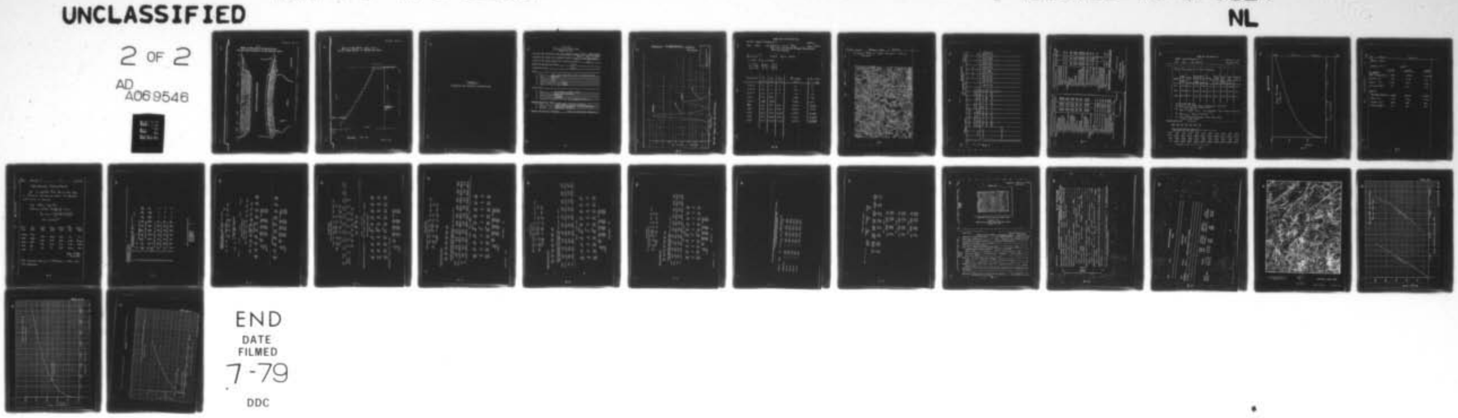

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7-79
DDC

Plate D-1

Dam of The Ravine Association
on the North Branch of the Raritan River

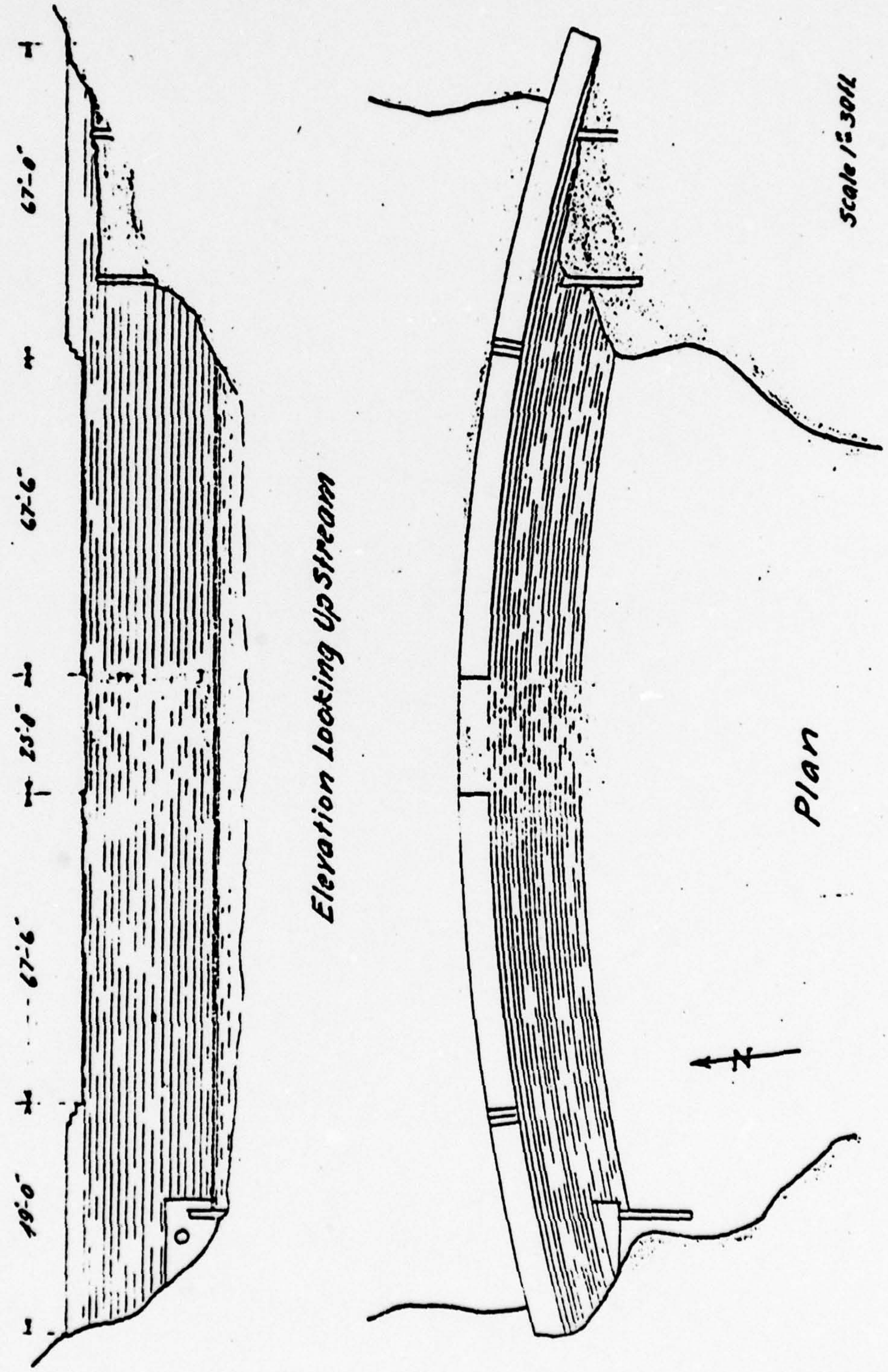
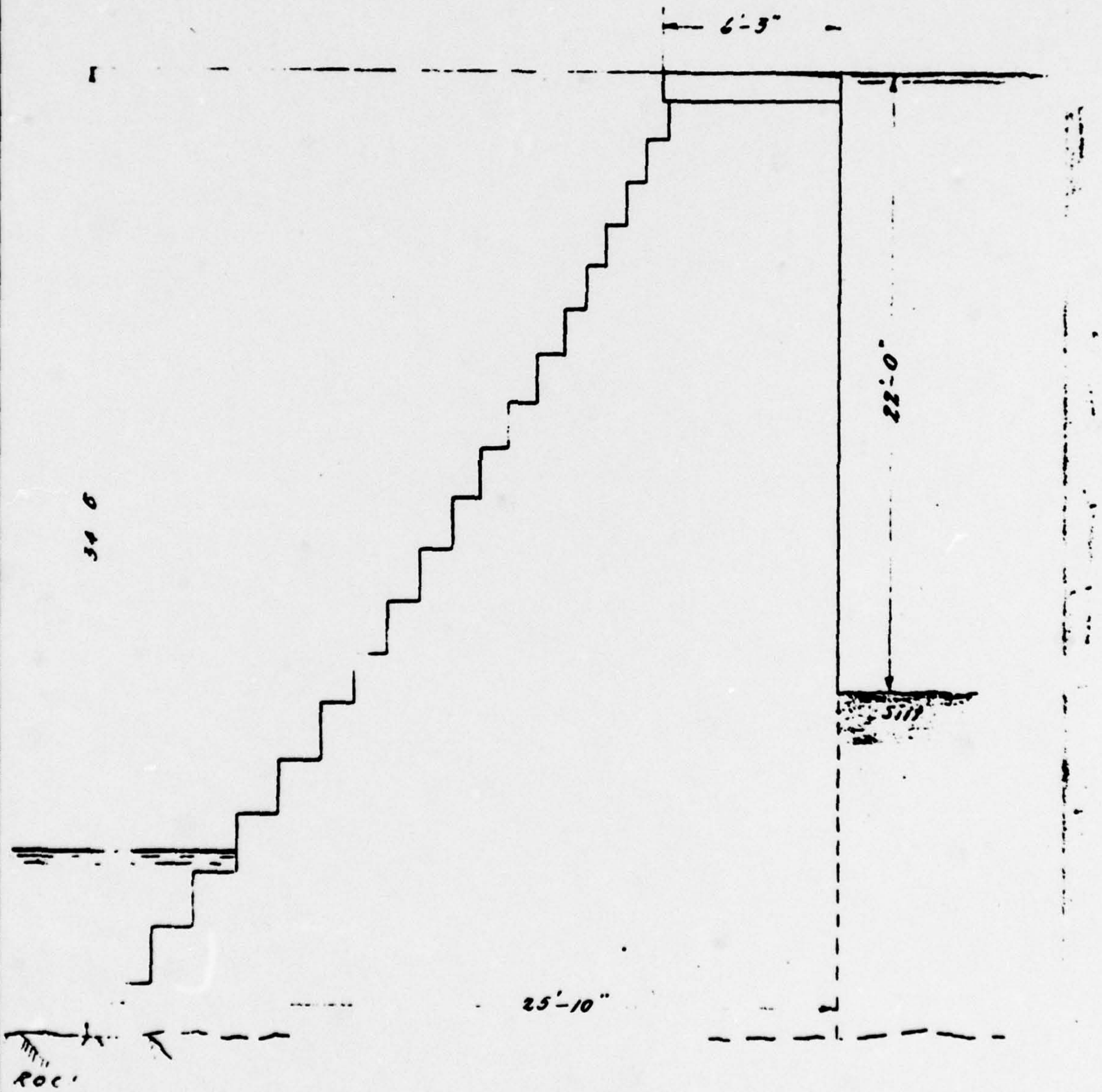


Plate D-2

Dam of the Ravine Association
on the North Branch of the Raritan River



Spillway Section

Scale 1" 5ft

APPENDIX E

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 26.2 square miles, mostly undeveloped, Elev.: 240' to 1100'

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 226.2' (320 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 240.0

ELEVATION TOP DAM: 230.2

CREST:

a. Elevation 226.7 Main Spillway; 226.2 Spillway Notch
b. Type Masonry
c. Width 6'3"
d. Length 160'
e. Location Spillover Center
f. Number and Type of Gates None

OUTLET WORKS:

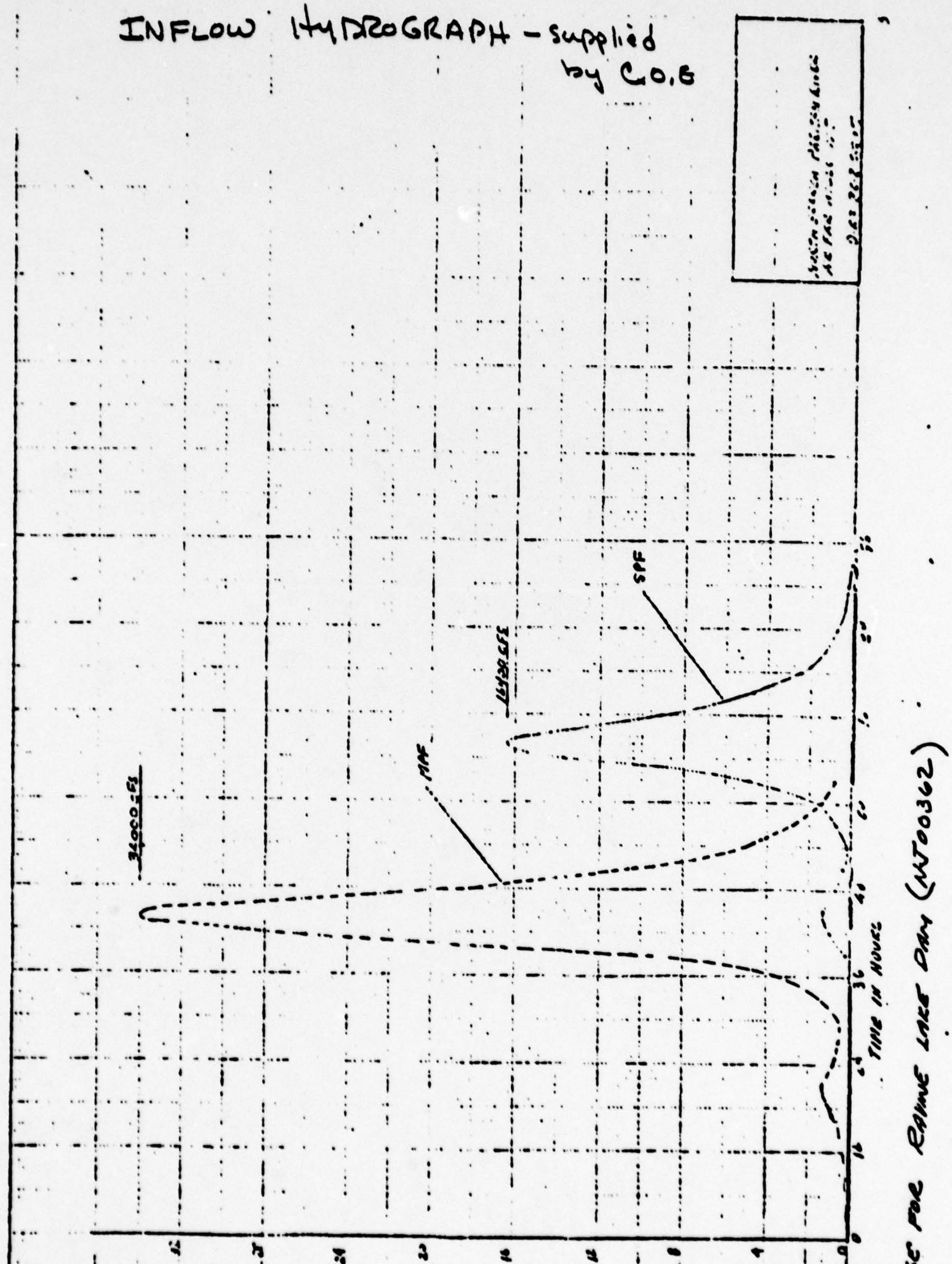
a. Type 6" diameter water supply
b. Location Near left abutment
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 48" diameter drain

HYDROMETEOROLOGICAL GAGES:

a. Type Staff gage, U.S.G.S. Station
b. Location Near left abutment, on left abutment
c. Records Unknown, U.S.G.S.

MAXIMUM NON-DAMAGING DISCHARGE: 3140 cfs (Spillway Capacity)

INFLOW HYDROGRAPH - supplied by C.O.E



LEEDS, HILL AND JEWETT, INC.

BY REE DATE 790103 CLIENT N.J. SHEET NO

CHKD DATE JOB Ravine Lake Dam JOB NO 302-C

Spillway & Overtop Stage-Discharge Rating Curve

$Q \doteq CLH^{1.5}$ $C = 2.9$ (FROM DATA)

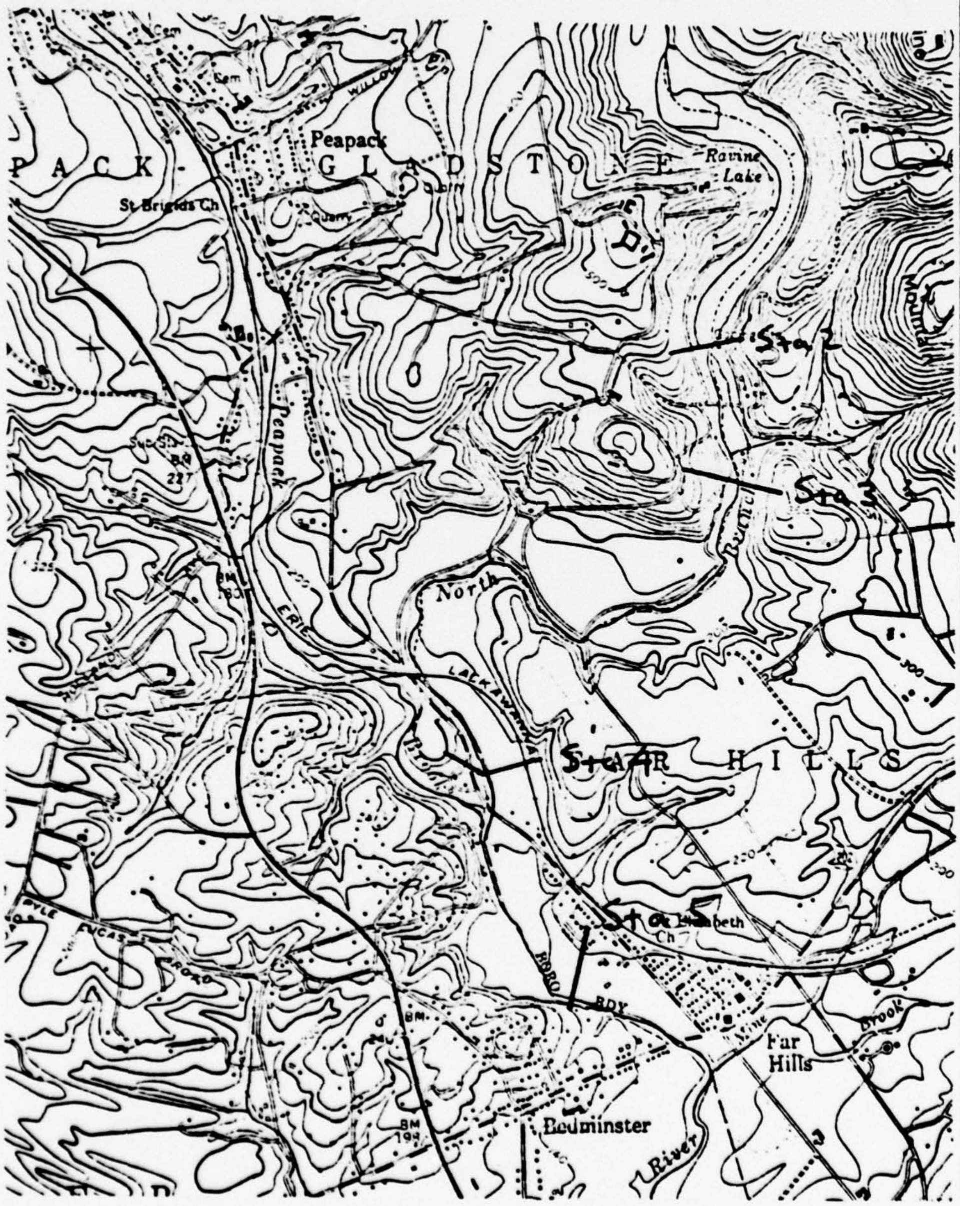
L FROM PLAN OF DAM

$L_1 = 25'$ @ EL 226.2
$L_2 = 135$ @ EL 226.7
$L_3 = 116$ @ EL 230.2

ELEVATION	Q_1 (CFS)	Q_2 (CFS)	Q_3 (CFS)	Q TOTAL (CFS)	$Q_1 + Q_2$ CFS
226.2	0	0	0	0	0
226.7	26	0	0	26	26
227.0	52	64	0	116	116
228	175	580		755	755
230.2	580	2564		3144	3144
231	762	3491	241	4494	4253
233	1286	6191	1576	9053	7477
235	1893	9362	3538	14793	11255
240	3717	17583	10320	31620	21300
245	5910	30648	19154	55712	36558

RBE 790213 | RAVINE LAKE | 302-83

LOCATION MAP OF CROSS-SECTIONS USED IN ROUTING



E-4

LEEDS, HILL AND JEWETT, INC.

BY RBC DATE 790203 CLIENT New Jersey SHEET NO. ___ OF ___

CHKD ___ DATE ___ JOB ___ JOB NO. 202-01

Ravine Lake

Channel Cross-Sections ℄

Station	Distance Downstream of Dam (ft)	Mannings "n" Left Overbank	Mannings "n" Main Channel	Mannings "n" Right Overbank	Channel Invert (ft)	Max Elev. (ft)	Reach Length (ft)	Energy Grade Line Slope	X or Y	1	2	3	4	5	6	7	8
2 - Below Dam	2000	0.10	.045	0.10	192 184	300	2000	.004	X	0	300	675	675	700	700	900	1100
									Y	300	200	186	184	184	186	220	300
3	10500	0.10	.045	0.10	135	160	8500	.006	X	0	225	250	250	275	275	325	1000
									Y	160	140	137	135	135	137	140	160
4	14000	0.10	.035	.10	122	160	3500	.004	X	0	50	100	100	150	150	750	1100
									Y	160	140	124	122	122	124	140	160

℄ Looking Upstream

E-5

E-6

Table 5-6. Values of the Roughness Coefficient n (continued)

Type of channel and description	Minimum	Normal	Maximum
C. Excavated or Dredged			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. Natural Streams			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

STATION 4

STATION 2,3

Table 5-6. Values of the Roughness Coefficient n (continued)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

OPEN-CHANNEL HYDRAULICS

STATION 2,3,4

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

BY RBE DATE 790119 CLIENT N. J. SHEET NO 1 OF 2

CHKD ____ DATE ____ JOB RAVINE JOB NO 302-03

PEAK DISCHARGE FOR DAM BREACH

% PMF	MAX W.S.E.L. NO BREACH [1]	DEPTH H (FT)	DISCHARGE NO BREACH (CFS) [1] Q_2 OVER DAM	Q_5 @ STA 5	Q_5/Q_2	FLOW AREA @ 4/9 H (FT²) [3]	Q_B FOR DAM BREACH (CFS) [4]	Q_B @ STA 5 (CFS) [5]	STAGE @ STA 5 [6]
25	232.68	27.7	8270	7990	0.96	2610	51965	49890	142.7
50	235.55	30.6	16530	15990	0.97	2890	60480	58500	144.0
100	240.00	35	31600	31260	0.99	3310	74080	73280	146.0

1. FROM HECJDB RUN
2. W.S.E.L − El. 205 (BOTTOM OF RESERVOIR WITH SILT)
3. FROM IDEALIZED DAM CROSS-SECTION
4. $Q_B = \left(\frac{2}{3}\sqrt{gH}\, A_{4/9}\right)$ FROM HENDERSON, "OPEN CHANNEL HYDRAULICS" 1966
5. $Q_{B @ STA\,5} = Q_{B @ 2}\,(Q_5/Q_2)$
6. FROM HECJDB DEVELOPED STAGE DISCHARGE CURVE FOR STA 5

NORMAL DEPTH CHANNEL ROUTING — STATION 5

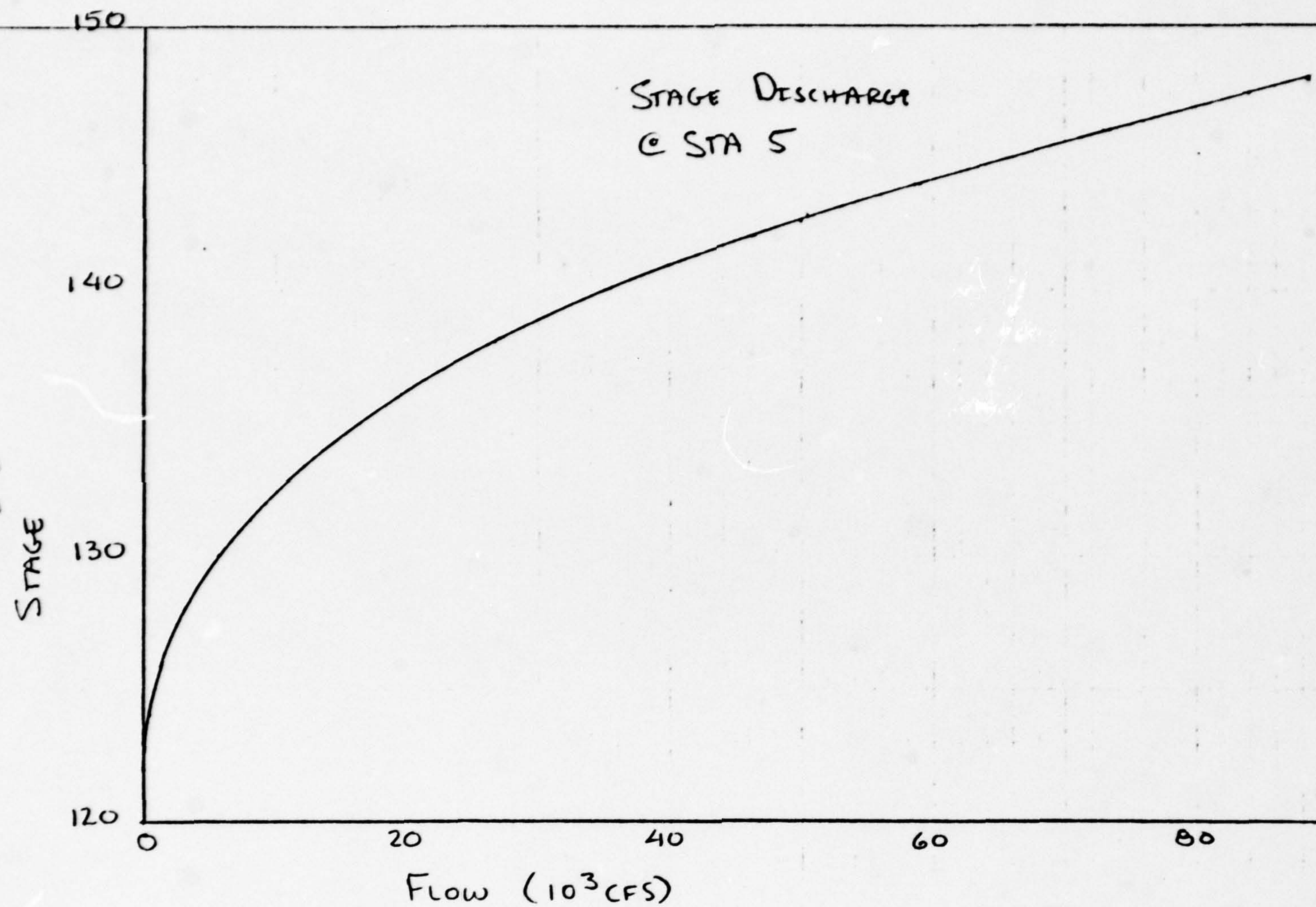
QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0350	.1000	122.0	160.0	3900.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 160.00 90.00 140.00 130.00 124.00 180.00 122.00 150.00 122.00
150.00 124.00 750.00 140.00 1130.00 160.00

STORAGE	0.00	0.07	22.63	53.22	93.89	144.63	211.62	291.20	384.17	443.13
	665.03	727.96	854.52	991.51	1132.92	1240.76	1435.03	1595.73	1762.06	1936.41
OUTFLOW	0.00	436.02	1359.41	3010.96	5522.02	9014.82	13620.05	19477.43	26084.08	35353.46
	46372.56	58873.76	72478.45	88377.15	105413.15	124031.87	144165.03	165934.34	189333.76	214343.42
STAGE	122.00	124.00	126.00	128.00	130.00	132.00	134.00	136.00	138.00	140.00
	142.00	144.00	146.00	148.00	150.00	152.00	154.00	156.00	158.00	160.00
FLOW	0.00	436.02	1359.41	3010.96	5522.02	9014.82	13620.05	19477.43	26084.08	35353.46
	46372.56	58873.76	72478.45	88377.15	105413.15	124031.87	144165.03	165934.34	189333.76	214343.42

7. BOTTOM ELEV @ STA 5 IS 122.0


STAGE DISCHARGE
@ STA 5
150
140
130
120
STAGE
0
20
40
60
80
FLOW (10³ CFS)

E-8

RBE 790122 | | 302-03

RAVINE LAKE

STATION 5 — PMF

	25%	50%	100%
NO BREACH			
PEAK DISCHARGE (CFS)	7970	15990	31260
DEPTH (FT)	9.4	12.8	17.1
WIDTH (FT)	350	490	660
VELOCITY (FPS)	5.0	5.3	5.7
BREACH			
PEAK DISCHARGE (CFS)	49990	58500	73280
DEPTH (FT)	20.7	22.0	24.0
WIDTH (FT)	755	780	820
VELOCITY (FPS)	6.2	6.5	6.9

DRAWDOWN CALCULATIONS

It is reported that Ravine Lake has a 48-inch emergency drain. No detailed information is known.

Use orifice equation
Assume orifice coeff of = 0.6

$$Q = 0.6 \times \left[\frac{\pi}{4}\left(\frac{48}{12}\right)^2\right]\sqrt{2gH}$$

$$Q = 60.5\,H^{1/2}$$

Elev. ft	Sto AF	Δ Sto AF	Avg H, ft	Avg Q cfs	Δ Drain hr.	Σ Drain HRS.
226.2	320					
		35	20.6	275	1.54	1.54
225	285					
		140	17.5	253	6.69	8.23
220	145					
		85	12.5	214	4.81	13.04
215	60					
		60	5	135	5.37	18.41
205	0					

Say 19 HRS

This estimate assumes no tailwater or inflow into the reservoir.

Plate E-3

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  25 SEP 78
**********************************
          A1       NEW JERSEY DAM SAFETY - RAVINE LAKE DAM  I.D. NO. NJ362
          A2       HYDRAULIC-HYDROLOGIC ANALYSIS   302-63
          A3       PROBABLE MAXIMUM FLOOD                                -RDE-
          B      31       2       0       0       0       0       0       0       0       0
          B1      5
          J       1       4       1
          J1   0.05    0.25     0.5     1.0
          K       0       1                                       1
          K1                       INFLOW HYDROGRAPH TO RESERVOIR
          M      -1            26.2            26.2                               1
          N       0       0     100     150     200     300     400     600     900    1200
          N    1000     900     600     500     500     800    2000    3600    7100   10100
          N   20600   34000   29300   20000   13000    7600    5000    3560    2260    1560
          N     900
          K       1       2                                       1
          K1                       ROUTED FLOWS THROUGH RESERVOIR
          Y                                1       1
          Y1      1                                             320      -1
          Y4  226.2   226.7     227     228   230.2     231     233     235     240     245
          Y5      0      25     120     755    3143    4250    7400   11255   21300   30500
          $A      9      63     145     205     329     500     790    1106    1670
          $E    205     215     220     225   226.2     230     235     243     245
          $$  226.2
          $D  228.2     2.9     1.5     116
          K       1       3                                       1
          K1          CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
          Y                                1       1
          Y1      1
          Y6    0.1   0.045     0.1     104     300    2000   0.064
          Y7      0     300     509     200     675     106     675     104     700     104
          Y7    700     106     900     220    1100     300
          K       1       4                                       1
          K1          CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
          Y                                1       1
          Y1      1
          Y6    0.1   0.045     0.1     135     160    8500   0.086
          Y7      0     169     225     140     250     137     250     135     270     135
          Y7    275     137     325     140    1000     160
          K       1       5                                       1
          K1          CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5
          Y                                1       1
          Y1      1
          Y6    0.1   0.035    0.10     122     160    3500   0.604
          Y7      0     160      50     140     100     124     100     122     150     122
          Y7    153     124     750     140    1100     160
          K      99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
ROUTE HYDROGRAPH TO	4
ROUTE HYDROGRAPH TO	5
END OF NETWORK	

NEW JERSEY DAM SAFETY - RAVINE LAKE DAM I.D. NO. 06362
HYDRAULIC-HYDROLOGIC ANALYSIS 382-03
PROBABLE MAXIMUM FLOOD -RBE-

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
31	2	0	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .05 .25 .50 1.00

********* ********* ********* ********* *********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	26.20	0.00	26.20	0.00	0.000	0	1	0

INPUT HYDROGRAPH

0.	0.	100.	100.	200.	300.	400.	600.	900.	1200.
1800.	400.	600.	500.	500.	800.	2600.	3600.	7100.	10100.
24000.	34000.	28000.	20000.	13000.	7600.	5000.	3500.	2200.	1500.
900.									

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	34000.	28667.	14167.	5073.	182050.
CMS	963.	812.	401.	166.	5155.
INCHES		10.10	20.12	21.55	21.55
MM		256.52	511.04	547.26	547.26
AC-FT		14215.	28099.	30091.	30091.
THOUS CU M		17534.	34660.	37117.	37117.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

0.	0.	100.	100.	200.	300.	400.	600.	900.	1200.
1800.	800.	600.	500.	500.	800.	2000.	3600.	7100.	10100.
24000.	34000.	28000.	20000.	13000.	7600.	5000.	3500.	2200.	1500.
900.									

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	34000.	28667.	14167.	5073.	182050.
CMS	963.	812.	401.	166.	5155.
INCHES		10.10	20.12	21.55	21.55
MM		256.52	511.04	547.26	547.26
AC-FT		14215.	28099.	30091.	30091.
THOUS CU M		17534.	34660.	37117.	37117.

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	320.	-1

STAGE	225.20	226.70	227.90	228.80	230.20	231.80	233.80	235.60	240.00	245.00
FLOW	0.00	25.00	120.00	755.00	3140.00	4250.00	7400.00	11255.00	21360.00	30563.00

CAPACITY=	0.	60.	145.	205.	320.	500.	790.	1103.	1670.
ELEVATION=	205.	215.	220.	225.	226.	230.	235.	243.	245.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
225.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
230.2	2.9	1.5	116.

STATION 2, PLAN 1, RATIO 4

ITERATIVE SOLUTION DID NOT CONVERGE 22 1 0.000 2.399E+02 -2.554E+03 2.400E+02 -2.261E+03

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	23.	106.	251.	355.	587.	764.	1130.
1994.	842.	676.	544.	495.	658.	1605.	3152.	6302.	16195.
26073.	31683.	30649.	28217.	14458.	7824.	5492.	3666.	2560.	1622.
1070.									

STORAGE

320.	320.	320.	342.	356.	360.	375.	387.	406.	422.
420.	409.	399.	389.	386.	394.	442.	512.	600.	825.
1075.	1100.	1159.	922.	703.	644.	585.	531.	485.	443.
419.									

STAGE

226.2	226.2	226.4	226.7	227.9	227.2	227.4	227.6	228.0	228.4
229.3	228.1	227.9	227.7	227.6	227.8	228.8	230.2	231.9	235.4
231.7	240.0	239.7	236.7	234.9	232.5	231.5	230.5	229.7	228.8
228.3									

PEAK OUTFLOW IS 31683. AT TIME 44.69 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31683.	28595.	14051.	5017.	160320.
CMS	895.	810.	398.	165.	5166.
INCHES		10.15	19.96	21.34	21.34
MM		257.91	526.86	542.06	542.06
AC-FT		14181.	27869.	29805.	29805.
THOUS CU M		17492.	34376.	36764.	36764.

E-13

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STA 2 TO 3

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.36	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
0	10000000	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0450	.1000	184.0	300.0	2000.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00	300.00	500.00	200.00	675.00	186.00	675.00	184.00	700.00	184.00
700.00	186.00	999.00	220.00	1169.00	300.00				

STORAGE	0.00	14.12	54.01	132.44	227.96	342.11	474.85	622.76	783.49	957.87
	1143.40	1342.72	1554.89	1779.72	2017.47	2268.36	2531.40	2807.74	3096.03	3398.76
OUTFLOW	0.00	1201.03	5735.73	15585.17	31769.69	54249.94	83675.73	121437.72	166410.51	218800.92
	278061.04	346838.72	423392.06	507623.14	600975.37	703332.59	814968.04	936153.65	1067159.00	1206254.36
STAGE	184.00	190.11	196.21	202.32	208.42	214.53	220.63	226.74	232.84	238.95
	245.05	251.16	257.26	263.37	269.47	275.58	281.68	287.79	293.89	300.00
FLOW	0.00	1201.03	5735.73	15585.17	31769.69	54249.94	83675.73	121437.72	166410.51	218844.92
	278061.04	346838.72	423002.06	507623.14	600975.37	703332.59	814964.04	936153.65	1067159.60	1206254.06

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	7.	22.	96.	240.	350.	492.	743.	1107.
1118.	859.	698.	549.	499.	637.	1518.	3065.	6121.	15594.
26686.	31450.	30045.	28743.	14486.	8421.	5203.	4086.	2366.	1097.
919.									

STOR

0.	0.	0.	0.	1.	3.	4.	6.	9.	13.
13.	13.	0.	6.	6.	7.	17.	32.	61.	132.
199.	226.	223.	183.	124.	78.	53.	42.	25.	21.
11.									

STAGE

184.0	184.0	184.0	184.1	184.5	185.2	185.8	186.5	187.0	189.6
199.7	188.3	187.5	188.0	186.5	187.2	190.5	192.6	196.4	202.3
206.5	208.3	208.1	204.3	201.6	197.9	195.5	194.0	191.7	191.0
188.7									

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31450.	28670.	14047.	5815.	180259.
CMS	891.	812.	398.	165.	5104.
INCHES		19.16	19.95	21.33	21.33
MM		258.55	506.71	541.86	541.86
AC-FT		14216.	27861.	29794.	29794.
THOUS CU M		17536.	34366.	36751.	36751.

MAXIMUM STORAGE = 226.

MAXIMUM STAGE IS 208.3

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
31	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0450	.1000	135.0	160.0	8500.	.00693

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 160.00 225.00 140.00 250.00 137.00 258.00 135.00 275.00 135.00
275.00 137.00 325.00 140.00 1000.00 160.00

STORAGE	0.00	6.42	13.01	28.51	51.70	86.10	139.62	206.34	286.27	385.39
	497.72	625.26	757.99	925.93	1099.07	1267.41	1493.96	1709.71	1943.66	2192.61
OUTFLOW	0.00	94.77	293.99	626.23	1130.48	1861.17	2926.46	4391.58	6317.50	8761.[illegible]
	11777.09	15415.71	19726.44	24756.58	30551.04	37156.57	44613.92	52965.9[illegible]	62253.6[illegible]	72517.14
STAGE	135.00	136.32	137.63	138.95	140.26	141.58	142.89	144.21	145.53	146.84
	148.16	149.47	150.79	152.11	153.42	154.74	156.05	157.37	158.68	[illegible]
FLOW	0.00	94.77	293.99	626.23	1130.48	1861.17	2926.46	4391.58	6317.50	8761.[illegible]
	11777.00	15415.71	19726.44	24756.58	30551.04	37156.57	44613.92	52965.91	62253.6[illegible]	72517.14

STATION 4, PLAN 1, RTIO 4

OUTFLOW

0.	0.	4.	15.	63.	206.	329.	449.	660.	998.
1144.	939.	722.	590.	504.	507.	1209.	2563.	5191.	12923.
24609.	31129.	31157.	23291.	15003.	9965.	5690.	4369.	2914.	1920.
1277.									

STOR

0.	1.	0.	1.	4.	10.	15.	21.	33.	46.
52.	47.	33.	27.	23.	27.	56.	122.	243.	530.
924.	1115.	1116.	890.	614.	436.	262.	203.	139.	91.
59.									

STAGE

135.0	135.0	135.1	135.2	135.5	137.0	137.8	138.2	139.1	139.9
140.3	139.8	139.2	138.8	138.5	138.8	140.4	142.4	144.0	148.6
152.1	153.5	153.5	151.7	149.4	147.4	145.1	144.1	142.9	141.7
140.5									

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31157.	28750.	14049.	5843.	1750[illegible].
CMS	882.	814.	398.	164.	5094.
INCHES		10.21	19.95	21.29	21.29
MM		259.35	506.80	540.79	540.79
AC-FT		14260.	27866.	29735.	29735.
THOUS CU M		17590.	34372.	36678.	36678.

MAXIMUM STORAGE = 1116.

E-15

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
0	10000500	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0350	.1000	122.0	166.0	3500.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 163.00 53.09 143.90 100.03 124.00 100.60 122.00 150.06 122.00
150.00 124.00 756.09 140.00 1150.00 166.00

STORAGE	0.00	4.03	22.63	53.22	94.09	144.63	211.62	291.20	384.17	483.13
	605.03	727.96	856.52	991.51	1132.92	1280.76	1435.03	1595.73	1762.06	1936.41
OUTFLOW	0.00	486.82	1365.41	3618.56	5522.62	9814.02	13626.85	19477.43	26684.66	35359.46
	46372.56	58673.76	72478.45	88377.15	105413.15	124831.87	144165.03	165934.34	189333.76	214393.42
STAGE	122.00	124.00	126.00	128.00	130.00	132.00	134.00	136.00	138.00	140.00
	142.00	144.00	146.00	148.00	150.00	152.00	154.00	156.00	158.00	160.00
FLOW	0.00	486.82	1365.41	3618.56	5522.62	9814.02	13626.85	19477.43	26684.66	35359.46
	46372.56	58673.76	72478.45	88377.15	105413.15	124831.87	144165.03	165934.34	189333.76	214393.42

STATION 5, PLAN 1, RTIO 4

OUTFLOW

0.	0.	3.	14.	55.	170.	317.	434.	644.	963.
1146.	978.	735.	602.	509.	571.	1124.	2345.	4669.	11952.
23735.	32905.	31259.	24245.	15525.	10482.	6054.	4292.	3154.	1933.
1303.									

STOR

0.	0.	0.	0.	1.	4.	6.	6.	12.	16.
15.	17.	13.	11.	19.	11.	19.	43.	63.	107.
346.	437.	448.	353.	237.	165.	99.	71.	52.	32.
23.									

STAGE

122.0	122.0	122.0	122.1	122.3	122.9	123.6	124.1	124.5	125.2
125.9	125.2	124.7	124.4	124.2	124.3	125.5	127.2	129.5	131.3
137.2	139.0	139.1	137.3	134.6	132.6	130.3	129.0	128.1	126.7
126.0									

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31259.	20745.	14053.	5799.	179759.
CMS	885.	814.	398.	164.	5093.
INCHES		10.21	19.96	21.27	21.27
MM		259.23	506.94	540.37	540.37
AC-FT		14254.	27874.	29712.	29712.
THOUS CU M		17582.	34382.	36650.	36650.

MAXIMUM STORAGE = 448.

MAXIMUM STAGE IS 139.1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .05	RATIO 2 .25	RATIO 3 .50	RATIO 4 1.00
				RATIOS APPLIED TO FLOWS			
HYDROGRAPH AT	1	26.20	1	1700.	8500.	17000.	34000.
	(	67.86)	(	48.14)(	240.69)(	481.39)(	962.77)(
ROUTED TO	2	26.20	1	1633.	8267.	16532.	31603.
	(	67.86)	(	46.23)(	234.10)(	468.13)(	894.89)(
ROUTED TO	3	26.20	1	1637.	8290.	16436.	31450.
	(	67.86)	(	46.36)(	234.74)(	465.41)(	890.56)(
ROUTED TO	4	26.20	1	1597.	8042.	16141.	31157.
	(	67.86)	(	45.24)(	227.71)(	457.07)(	882.27)(
ROUTED TO	5	26.20	1	1613.	7972.	15981.	31259.
	(	67.86)	(	45.68)(	225.75)(	452.43)(	885.17)(

17

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	226.20	226.20	230.20
STORAGE	320.	320.	512.
OUTFLOW	0.	0.	3140.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	228.41	0.00	444.	1633.	0.00	44.00	0.00
.25	232.64	2.48	655.	8267.	12.00	44.00	0.00
.50	235.55	5.35	833.	16532.	14.00	44.00	[illegible]
1.00	240.00	9.60	1146.	31603.	22.00	44.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.05	1637.	190.7	44.00
.25	8290.	197.8	44.00
.50	16436.	202.6	44.00
1.00	31450.	208.3	44.00

PLAN 1 STATION 4

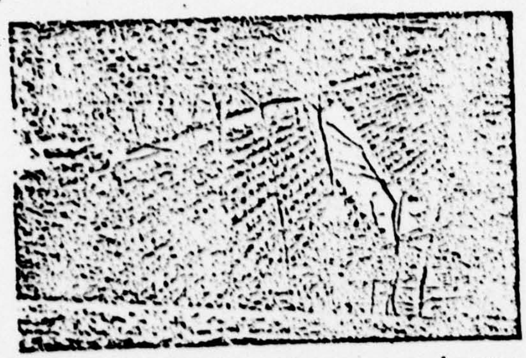
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.05	1597.	141.1	46.00
.25	8042.	146.5	44.00
.50	16141.	149.7	44.00
1.00	31157.	153.5	46.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.05	1613.	126.3	46.00
.25	7972.	131.4	46.00
.50	15991.	134.8	44.00
1.00	31255.	139.1	46.00

No. BRANCH RARITAN RIVER
No 25-54

RAVINE LAKE



Dam from roadway along west (right) side.

Dam No. 25-54
North Branch Raritan River, Somerset County
October 25, 1949

Form 11—SC—3-50

NO. BR. RARITAN RIVER

DAMS IN NEW JERSEY—REFERENCE DATA

No. 25-54

Name of Owner: Ravine Association
Address: c/o Clarence V.S. Mitchell, Choate, Mitchell & Ely, 41 Broad St./ N.Y.C.

Name of Lake: Ravine Lake
County: Somerset
Location: 25.22.1.9.2

Stream: North Branch Raritan River
Tributary to: Raritan River

Drainage Basin: Area 26.2 sq. mi. Description:

Valley below Dam: Sparsely settled

DAM: Purpose: Pleasure and private power supply
Constructed: 1899

Type: Rock masonry gravity section
Foundation: Ledge rock

Length: 271 ft. Max. Height: 35 ft. Min. Top Width: 4± ft.

Upstream Slope: Slight batter
Downstream Slope: Stepped
Core Wall: None

Previous Failures: None

SPILLWAY: Type: Rock masonry, same section as dam

Length: * ft. Weir Coeff.: 2.92** Depth below top of dam: * ft.

Capacity: * sec. ft. at * ft. hd. Est. yr. flood sec. ft.

RESERVOIR: Capacity: 350 M. G. Area: 77 acres Normal W. L. El.: * (datum)

Outlets: No data

REMARKS: ** Computed from U.S.G.S. Rating Curve. Entire dam may be overtopped without damage.

Sources of Data: Letter from F. S. Taintor 7/11/23, U.S.G.S. and Riparian Stream Survey
Date: 10/25/49 inspection

E-19

Form 11—SC—2-50

NO. BR. RARITAN RIVER

DAMS IN NEW JERSEY—REFERENCE DATA No. 25-54

Name of Owner Ravine Association Address c/o Clarence Y. S. Mitchell Choate, Mitchell & Ely, 11 Broad St./ N.Y.C.

Name of Lake Ravine Lake County Somerset Location 25.22.1.9.2

Stream North Branch Raritan River Tributary to Raritan River

Drainage Basin: Area 26.2 sq. mi. Description

Valley below Dam Sparsely settled

DAM: Purpose Pleasure and private power supply Constructed 1899

Type Rock masonry gravity section Foundation Ledge rock

Length 271 ft. Max. Height 35 ft. Min. Top Width 4± ft.

Upstream Slope Slight batter Downstream Slope Stepped Core Wall None

Previous Failures None

SPILLWAY: Type Rock masonry, same section as dam

Length * ft. Weir Coeff. 2.92** Depth below top of dam * ft.

Capacity * sec. ft. at * ft. hd. Est. yr. flood sec. ft.

RESERVOIR: Capacity 350 M. G. Area 77 acres Normal W. L. El * (datum)

Outlets No data

REMARKS: ** Computed from U.S.G.S. Rating Curve. Entire dam may be overtopped without damage.

Sources of Data Letter from F. S. Tainter 7/11/23, U.S.G.S. and Riparian Stream Survey Date 10/25/49 inspection

Form 180

E-20

CHANGES IN OWNERSHIP

Date	Name	Address

INSPECTIONS

Date	Made by	Remarks
10/25/49	N.C.W.	Dam in excellent condition.
5/15/51	"	" " " "

	Length	Depth below top	Capacity dam crash sec.ft.	Capacity 0.52' F. B. sec. ft.	Crest Elevation
Notch	25.5 ft.	4.02 ft.	602	486	226.17
Main Crest	136.4 ft.	3.50 ft.	2620	2040	226.69
Totals	161.9 ft.		3222	2526	

E-21

0 2000 4000 6000 8000 10,000

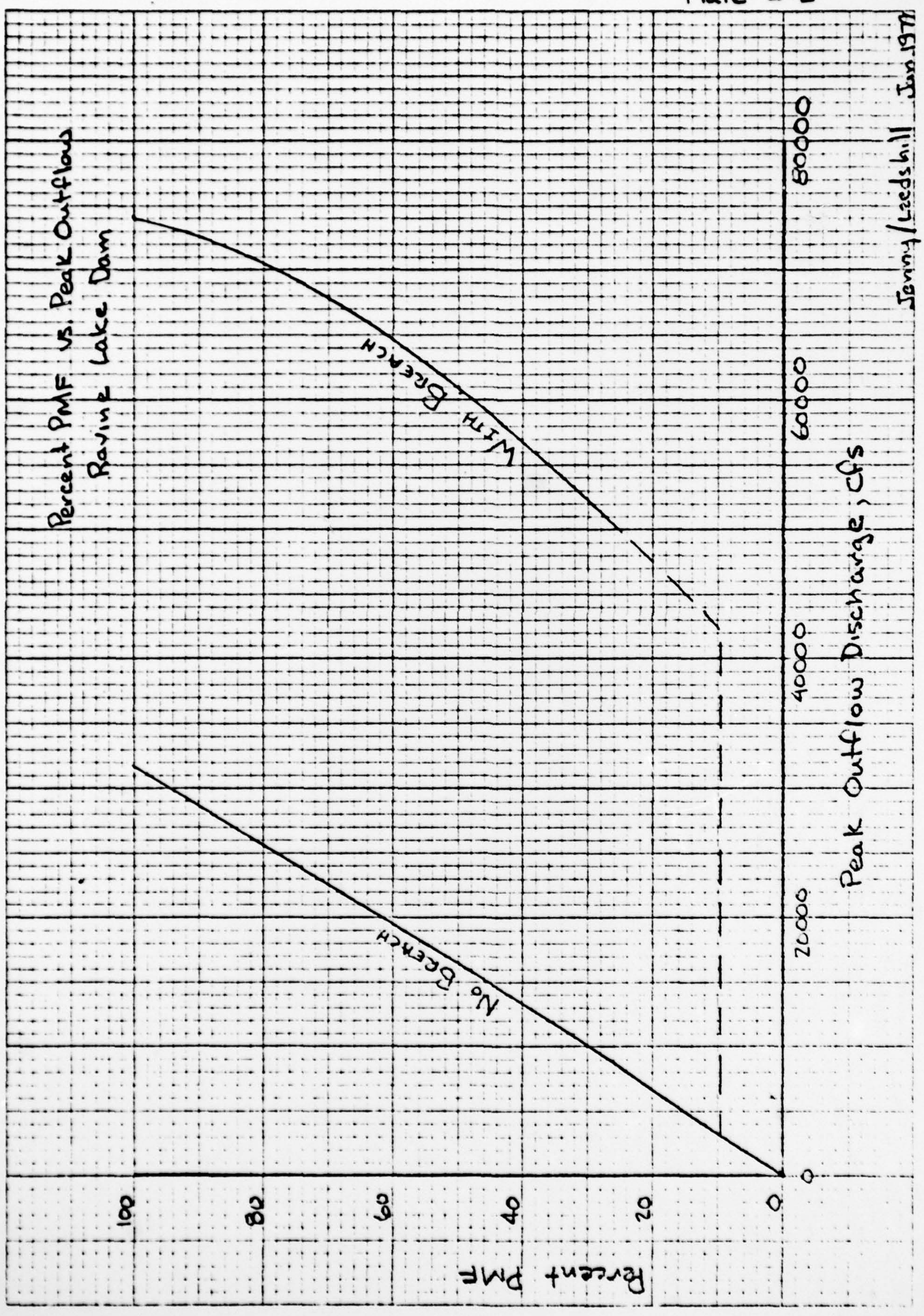
SCALE IN FEET

AREA LOCATION

RAVINE LAKE DAM

JENNY-LEEDSHILL JANUARY 1979

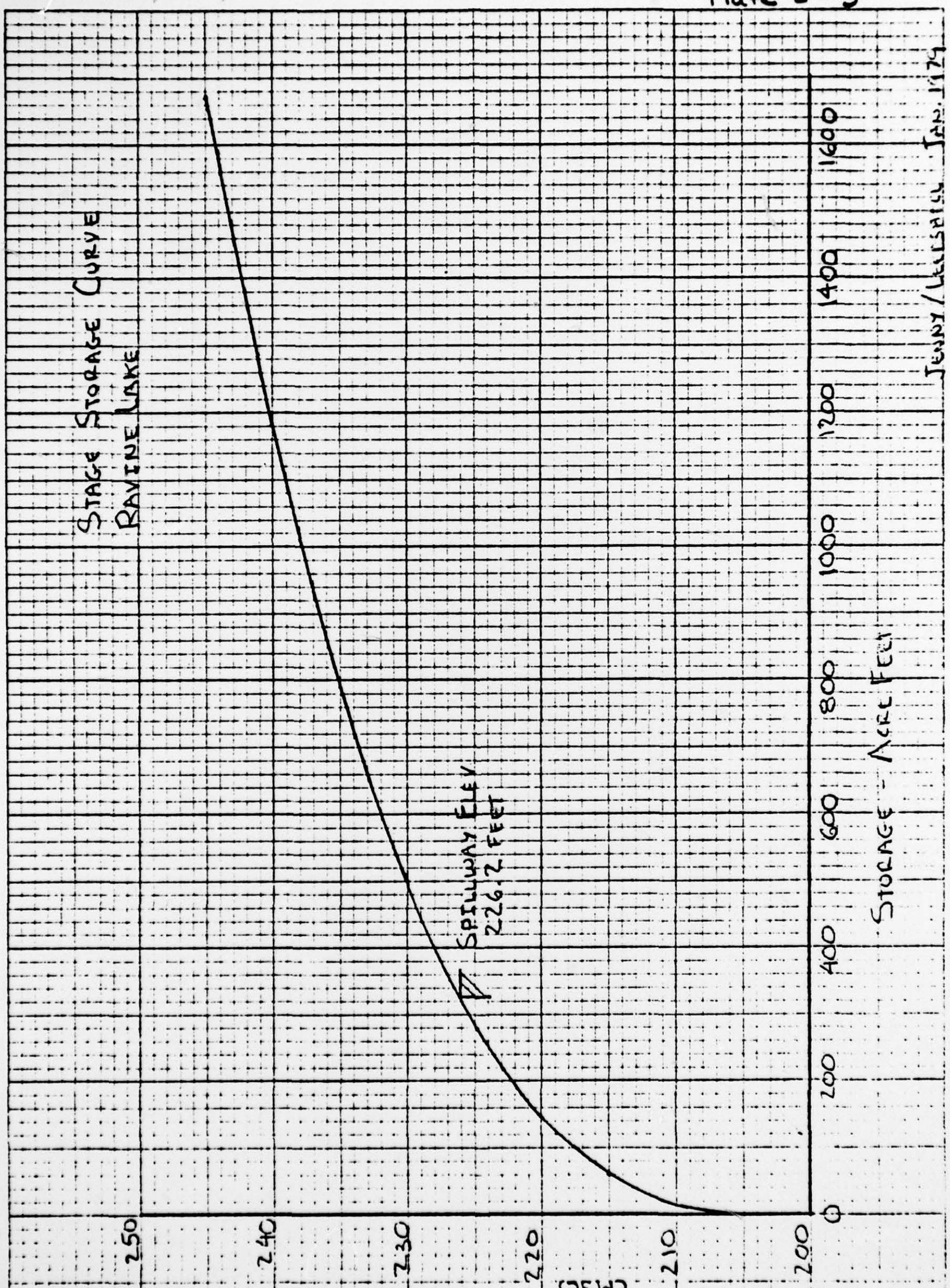
Plate E-2



Percent PMF vs. Peak Outflow
Ravine Lake Dam
With Breach
No Breach
Percent PMF
100
80
60
40
20
0
0
20000
40000
60000
80000
Peak Outflow Discharge, CFS
Jenny/Leedshill Jun 1977

E-10

Plate E-3


STAGE STORAGE CURVE
RAVINE LAKE
SPILLWAY ELEV
226.2 FEET
STORAGE - ACRE FEET
ELEVATION - FEET
(MSL)
0
200
400
600
800
1000
1200
1400
1600
200
210
220
230
240
250

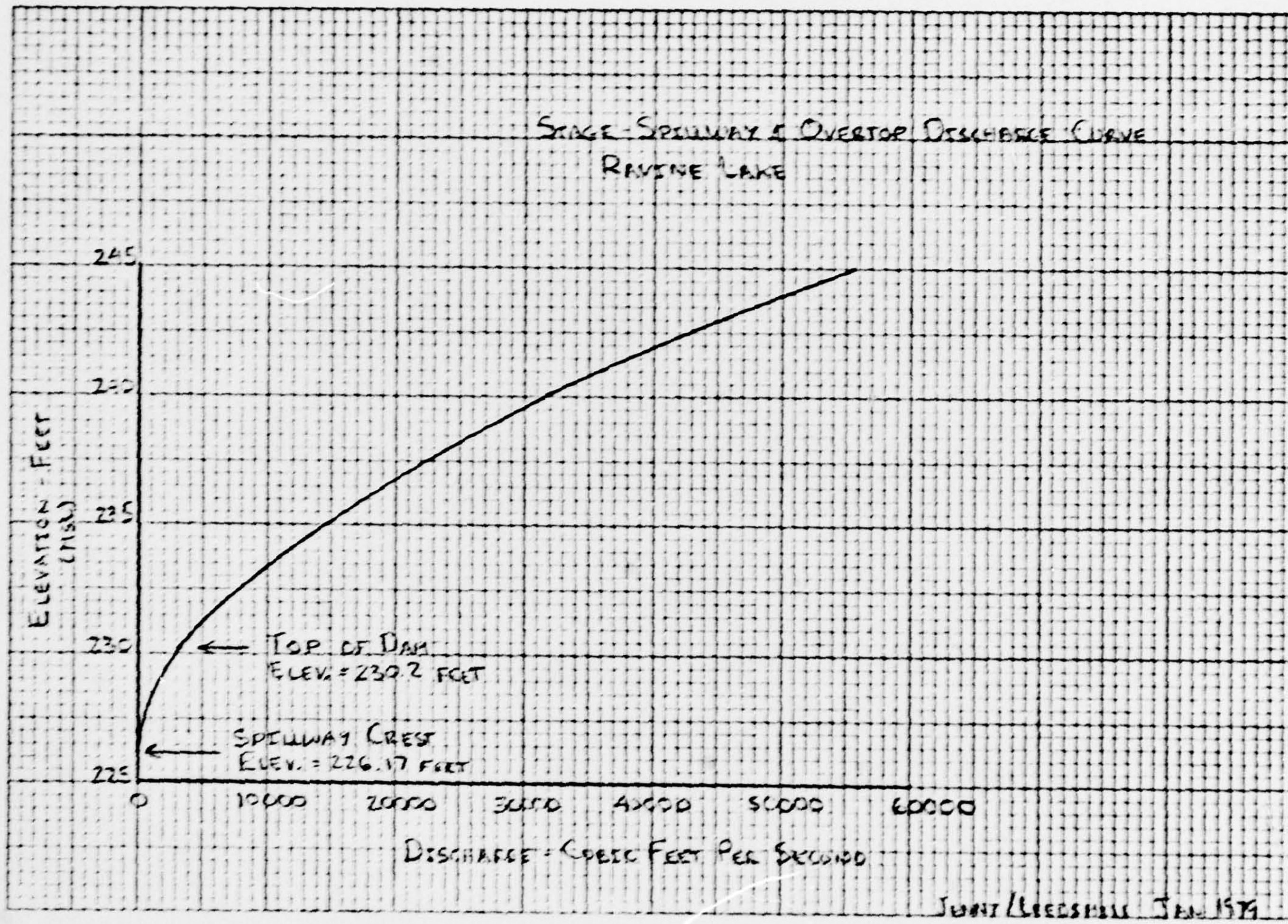

STAGE-SPILLWAY & OVERTOP DISCHARGE CURVE
RAVINE LAKE
ELEVATION - FEET (MSL)
245
240
235
230
225
TOP OF DAM
ELEV. = 230.2 FEET
SPILLWAY CREST
ELEV. = 226.17 FEET
0
10000
20000
30000
40000
50000
60000
DISCHARGE - CUBIC FEET PER SECOND
JENNY/LEEDSHILL JAN 1979

Plate E-4